Research Report:

Taxonomy 'Interactive Art'

II. Phase

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1. Objectives and project phases

The Prix Ars Electronica which has been awarded annually since 1987 is currently accepting submissions in eight categories (digital musics, computer animation, interactive art, hybrid art, digital communities, Media.Art.Research Award, a youth competition U19 and the honour award 'Next Idea'. Submissions are open to all. International juries select a winner, two Awards of Distinction and up to twelve 'Honorary Mentions' for each category. The award ceremony for these takes place during the Ars Electronica Festival.

Using the example of the 350 works submitted in the category of interactive art in the year 2007, a taxonomy of interactive art was developed and evaluated. This taxonomy was then used on the one hand for a retrospective attribution of keywords for the respective 15 prizewinning projects of 1990-2009, and, on the other hand, integrated into the online submission tool, allowing submitting parties to index their own works autonomously since 2008.

1.1 Objectives

- Methodological discussion of the relevance of taxonomies for the research of media art
- Developing a higher degree of differentiation of this heterogeneous field of art forms described as 'interactive art' and a more detailed description of their aesthetic, technical and structural characteristics
- Development of a proposal for the attribution of keywords for entries to the category of 'interactive art' in the archive of Ars Electronica
- Providing access to an important part of the archive of Ars Electronica by indexing 300 winning projects between 1990-2009
- Further continuous survey of keywords for the category of interactive art by implementing a submitting parties' indexing since 2008
- Visualisation of gathered data using an explorative information structure

1.2 First Project Phase (cf. Research report 06/2007[1])

- Evaluation of existing approaches to the classification of media art
- Evaluation of existing approaches to the classification of interactive art
- Sighting and evaluation of submissions for the Prix Ars Electronica 2007 in the category of 'interactive art'
- Development of a first draft of the taxonomy 'interactive art'
- Initial use of taxonomy on the sighted projects 2007 (see ANNEX 1)
- Evaluation of taxonomy

1.3 Second Project Phase (current report, 11/2009)

- Revision of the first draft of taxonomy 'interactive art'
- Implementation of taxonomy in the submission process of the Prix Ars Electronica to allow submitting parties to attribute their own keywords
- Retrospective indexing of annual fifteen winning projects of the category 'interactive art' of the years 1990-2009
- Comparison and evaluation of the retrospective attribution vs. the attribution of keywords by artists
- Determination of keyword definitions
- Visualisation

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[1] online under http://www.media.lbg.ac.at/media/pdf/Taxonomy_IA_200706.pdf

1.4 Parallel project: Taxonomy 'Hybrid Art'

The first project phase coincided with the introduction of the new award category 'Hybrid Art'. Subsequently, a significant decline in submissions for the category of 'interactive art' was recorded (350 in the year 2007 in comparison to 600 in the preceding year). This indicates, that artists who previously would have submitted or even had submitted their works in the category of 'Interactive Art', now considered the new category to be more appropriate. Indeed, even a quick overview discovered significant overlaps with entries in the category of interactive art, especially in the area of performance, but also with regard to the use of mobile media. In retrospect, it can be assumed, that many of the previous entries to the competition had been so far submitted under the general category of 'interactive', as the open, alternative category now provided by 'hybrid art' had not been available. This is why a comparison of the works in the new category of 'Hybrid Art' seemed to be very helpful for the taxonomy of interactive art, in order to extract ' characteristics of such works which were not interactive in the proper sense however which were submitted and also generally understood as being so. Subsequently, the sub-project 'taxonomy Hybrid Art' was assigned to the cultural scientist Heike Helfert. The development and the use of an equivalent taxonomy for hybrid art should provide findings with regard to overlaps and differences between the two categories. A research report is available on this.[2]

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[2] Cf. Research report ‚hybrid art' by Heike Helfert, 9/2009 –
http://www.media.lbg.ac.at/media/pdf/taxonomy_HY_200909.pdf

2. Implementation of taxonomy into the process of submissions for the Prix

2.1 Revision of the taxonomy

The implementation of the taxonomy as an option allowing submitting parties to attribute keywords requires the use of terminology which is as generally intelligible as possible. The terminological hierarchy consisting of keyword categories and keywords should be justified and easily understandable by the submitting parties. This is even more important, as each keyword category should provide an option to insert own terms. Results of the taxonomy's revision which was undertaken for the implementation in the submission tool are documented in ANNEX 2.

2.1.1 General adaptations for the purpose of implementation

The taxonomy was now consistently produced in English language. As international artists predominantly apply for the Prix of Ars Electronica, allowing for attribution of keywords in English makes sense. Offering keywords in two languages was to be prevented, as an unambiguous translation is not possible in many cases, as these always have slightly different denotations. In order to ensure the understanding on behalf of the submitting parties, genuine terms were provided with short definitions in the German and English language.
The possibility to insert new keywords was to be made available, in order to admit newly emerging terms or terms which are currently particularly frequently used. The option was to fully integrate some of these terms after thorough examination into the taxonomy's core. Following this decision, the diversity of keywords in the category of 'media' was substantially reduced, as it did not seem to make sense to enumerate all media and technologies which are feasible for interactive works, especially, as submitting artists can add keywords to this by their own proposals. Whereas here the number of possible keywords to be selected or to be added is unlimited, it was limited to three in the remaining keyword categories.

2.1.2 Renaming and repositioning of keyword categories

Keyword categories were supposed to constitute levels of meaning which cluster keywords in a form which is as general and as accurate as possible. Furthermore, they were to clearly focus on specific characteristics of interactive art. A particular challenge proved to be to appropriately put interaction into keywords. As a first, the category 'type of interaction' was renamed into the category 'the visitor/performer does', whereas the category topic/strategy was divided into the category 'topic' which focuses on content and the interaction specific category 'the work/project does'. The categories 'input device' and 'output technology' were brought together under the generic term of 'media', as the differentiation between input and output is often either self-explanatory (e.g. a projector usually can only be used as an output device, a microphone, however, only as an input device), or nonsensical (in hybrid devices such as the mobile phone).

In order to more clearly characterise the terms mentioned in the category of 'technical character', they were now designated as 'catchwords'. This designation reflects the research group's finding that general technical terms (such as 'virtual reality' or 'locative media') are often owed to trends in society and visions and therefore have a more striking character. The category mainly contains genre-specific keywords which were established in context with interactive art and which convey a distinct meaning which goes beyond their literal content.

Changes in taxonomy 2007 − 2008	
Keyword categories 2007	**Keyword categories 2008**
Form	form of artwork
Range	range of artwork
Interaction	interaction partners
type of interaction	the visitor/performer does
topic/strategy	the work/project does
	topic
processing technology	processing technology
input device	media
output technology	
technical character	catchword

2.1.3 Additions, deletions and repositioning of catchwords

Furthermore, within categories, keywords were added or deleted or transferred to other categories (thus, for example, works which in the past were labelled as 'sound installation' can be better described with the more general term of 'installation', as the use of sound is captured separately under the category of 'media'). For a comprehensive comparison refer to ANNEX 1 and ANNEX 2.

As an example, modifications within the first three keywords categories are documented here by way of comparison, as these are of particular interest for the aesthetic description of the works.

Changes 2007 > 2008 in the first three keyword categories		
Keyword category	**Keywords 2007**	**Keywords 2008**
form of artwork	installation	installation
	sound installation	
	sculpture	sculpture
	object	object
	performance	performance
	experiment	
	software-application/program	software application/program
	net art	
	other	
range of artwork	stand-alone	stand-alone
	public space	public space
	separate sites	separate sites
	mobile	mobile
	networked internet	networked
	networked wireless	virtual worlds (e.g. Second Life)
	networked LAN	
	networked telephone network	
	other	
interaction partners	human >< human (mediated by computer)	human>human (artist interaction)
	human >< human (not mediated	human><human (audience interaction)
	human >< computer	human><computer
	bodily functions >< computer	
	environment >< computer	computer><environment
	external digital data >< computer	computer><external digital data
	computer >< analog device	computer><analog devices
	computer >< computer	computer><computer
	none	
	other	

The option 'none' (none applicable) was removed from the category of 'interaction partners' in order not to cause confusion in the area where artists could attribute keywords themselves. In the first version of the taxonomy, which was only applied by the research group, it was helpful to bookmark works which according to the research group's understanding were not to be designated as being interactive. If an artist submits a work for the category of interactive art, it would be extremely confusing, if this category offered the option to classify works as not being interactive. Also, the option 'other' (something else is applicable) was removed as a keyword option from the categories, as now the possibility is given to add own terms which specifically are intended to more closely describe this different character. 'Networked wireless', 'networked LAN', 'networked telephone network' were summarized under 'networked', as specifications regarding the technical implementation can be listed in the category of 'media'.

2.1.4 Redefining of keywords from nouns to words in the categories 'type of interaction' and 'topic/strategy'

The keywords of the categories 'type of interaction' and 'strategy' focus on the works' aesthetic characteristics. Keywords which existed as nouns were turned into verbs, as interactivity manifests itself in processes. This was an approach which had already been contemplated as a result of the first project phase and had been suggested by Gerhard Dirmoser[3]. Nouns are not capable of conveying the action in its context of directionality. However, this is essential for an exact description of interrelated processes, e.g. between the work and its recipient audience. Thus, the term 'observation' leaves open whether the work observes the observer or vice versa. However, if one chooses the wording of 'the observer can – observe', then the direction is clearly defined in this classification.[4]

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[3]   See. Research report, first part, 6/2007. Gerhard Dirmoser is a computer scientist and systems analyst.
[4]   Cf. The use of such a classification in form of verbs in the ANNEX of the exhibition catalogue of the exhibition 'Arte Virtual', Metro Opera Madrid 2004, published by Raffael Lozano Hemmer where, in a spreadsheet overview (p. 21) the question 'Que hace el Publico' is asked for each installation and descriptions are given by using terms such as moverse, observar, sentarse etc.

Transformation into verbs in the categories of type of interaction and topic/strategy	
Category and keywords 2007	**Category and keywords 2008**
type of interaction:	**the visitor/performer does:**
Observation	observe
Exploration	explore
Activation	activate
Control	control
Selection	select
Navigation	navigate
Participation	participate
	leave traces
co-authoring	co-author
communication	exchange
Collaboration	
None	
other	
topic/strategy	**the work/project does:**
Surveillance	monitor
instrument/ tool	serve as an instrument
trade/exchange	
Narration	tell, narrate
documentation	document
Perception	enhance perception
Game	offer a game
communication	enable communication
visualization	visualize
Sonification	sonificate
metamorphosis	transform
memory/storage	Store
Immersion	immerse
cybernetic/closed system	process
interface design	mediate
Other	

2.2 Technical execution of the implementation

In the autumn of 2007, the attribution of keywords was technically implemented on the submission platform of Ars Electronica. For this purpose, Günther Kolar, key researcher at LBI Media.Art.Research., changed the digital entry form in such a way, that once personal data had been entered, the form for the attribution of keywords becomes accessible. By mouse click, artists can activate keywords which they consider to be correct or add new keywords in

the provided text box. As has been described before, the insertion is limited to three keywords per category, with the exception of the category 'media'. Explanations about keywords are available via mouse-hover.

In coordination with Ars Electronica the attribution of keywords was not designed in the form of mandatory fields for the finalisation of the submission process – an entry could also be submitted without attributing any keywords. See ANNEX 2.

2.3 Evaluation of the attribution of keywords by artists 2008

For the purpose of evaluating the attribution of keywords by submitting artists, Günther Kolar programmed a statistical model, from which one can access the works' sets of data which are described by the corresponding keywords. In this statistical model, a distinction is drawn between terms attributed by artists and those which have been chosen from the taxonomy.

2.3.1 Quantitative Evaluation

Of 393 projects submitted in total, 312 contained keywords which had been attributed by the submitting artists. This represents a very good feedback to the offer of keyword-attribution and confirms its practicability.

Statistic overview of keyword attribution by submitting parties			
Keyword category	Average number of submitted keywords per artwork	Total number of submitted keywords	Newly introduced keywords
form of artwork	2	618	30
range of artwork	1,8	559	25
interaction partners	2	627	35
the visitor (performer) does	2,9	896	21
the work (project) does	2,8	879	23
Media	2,7	845	58
processing technology	1,6	499	84
catchword	1,9	577	86
topic	2,4	742	127

Most frequently attributed keywords		
Keyword category	Most frequent keyword per category	Number
form of artwork	installation	295
range of artwork	stand-alone	222
interaction partners	human><computer	269
the visitor (performer) does	participate	177
the work (project) does	visualize	135
media	projection	159
processing technology	motion capture	103
catchword	interactive cinema	89
topic	social relations	118

Most frequently attributed catchwords facilitate conclusions about the dominance of specific characteristics. It becomes apparent, that the submitted interactive works are, according to the submitting parties, almost exclusively (94%) installations or works which have among other things an installation characteristic. Three quarters of those artworks are not networked. The focus is clearly on human-machine-interaction (86%). In more than half of all works (56%) the form of interaction was characterised as participation. In 43% of all cases, the artwork visualises something. However, in this context, the keyword 'visualise' is often not to be understood in the narrower sense of transferring information structures into an image (ref. ANNEX 4), but very generally as visual representation. Half of the works make use of projection technologies. In just as many artworks, motion-capturing methods are used. This is an interesting fact which brings up the question which methods in particular are considered to be motion capturing and have been developed as such. Just as interesting is the amount of works (37%) which focus on issues of social relationships.

2.3.2 Qualitative evaluation 2008

Of particular interest were new keywords which were added to the different categories by the submitting parties. This option was quite frequently used – 489 proposals were made alone during the submission process of 2008.

Among these, the following keywords were proposed and attributed several times.

Newly and more than once proposed keywords		
Keyword category	**Proposals by submitting parties**	**How often assigned**
form of artwork	audience participation interactive	2
range of artwork	interface	2
interaction partners	human>< environment	5
	human><sculpture	2
the visitor/performer does	play	3
the work/project does	converse	2
media	sensors	4
	computer vision	3
	physical computing video Game	2
processing technology	bluetooth computer vision	3
	custom-made Java application	2
catchword	communication Art data visualization interactive sound Web 2.0	2
topic	identity music	3
	architecture game values poetics time	2

All proposals by artists which were only attributed to one artwork are documented in ANNEX 3.

In general, the keywords attributed by artists can be characterised as follows:

1.) Keywords which are already listed in a different category of the taxonomy. The term 'infrared light' was added to the category of 'processing technology', although it is already offered in the category of 'media'

2.) Keywords which individually specify one's own artwork, e.g. 'interactive experiment with multiple facets and related exhibition and lectures' (in the category of 'range of artwork')

3.) A use of terms which was intentionally avoided in the taxonomy as such terms seemed to be too general, e.g. 'play' and 'interact' in the category of 'the visitor/performer does'

4.) Keywords which provide a sensible addition to the taxonomy, e.g. fast fourier transformation', 'arduino' etc. in the category of 'processing technology'

5.) Keywords which are synonymous or similar to terms already offered such as 'movement recognition' instead of 'motion tracking'

6.) ,Counter-keywords which were intentionally placed as comments to keywords offered, such as 'de-enhance perception' in analogy to the existing term 'enhance perception' or 'high-tech' as antonym to 'low tech'
The high number of new keywords is particularly surprising in comparison to the relatively limited number of new proposals in the category of 'media'. The multiple proposals in the category of 'form of artwork' are also surprising. However, the type of proposals in formal and aesthetic categories ('form of artwork', 'range of artwork', 'interaction partners', 'the visitor/performer does', 'the work/project does') seems to indicate that misunderstandings or a lack of insight into these categories were the reasons for choosing own keywords. This is why one should consider to refrain from offering the option of alternative proposals for these categories, in order to motivate submitting parties to classify their artworks as precisely as possible within the formal-aesthetic context, or one could consider to change the order of categories so that categories which are possibly more easily understood such as 'topic' and 'catchword' come first. The attribution of keywords and proposals in other keyword categories which related more to the individual quality and character of the artwork, were – on the contrary – very helpful. In particular, the frequent use of new keywords in the category 'catchword' reflects interesting tendencies in the development of interactive art (e.g. 'physical computing'). Similarly, the terms 'identity' and 'music' which were proposed for the category 'topic' represented meaningful additions. It is feasible to use the suggestions made in these categories for an expansion of the taxonomy.

3. Retrospective attribution of keywords for/of the winning projects 1990 to 2009

In order to learn more about developmental tendencies in interactive art since the establishment of the Prix category, a retrospective attribution of keywords for all awarded projects in the category 'interactive art' since 1990 took place in March 2008 (in June 2009 this index was supplemented by the years 2008 and 2009). Among awarded projects are all works nominated for the Golden Nica, for an Award of Distinction or an 'Honorary Mention' - in total 298 projects (up to and including 2009). The winning projects constitute a representative sample of the heterogeneous submissions to the category 'interactive art', insofar as jury members change year by year and – as jury statements show apart from the quality of works the attempt to represent the current state of interactive art also determines the jury's decision. The attribution of keywords to all archive collections would not have been practicable in time, nor would it have been proportionate with regard to the results.

3.1 Technical prerequisites

The already existing tool for the attribution of keywords was adapted and linked to the content management system of Ars Electronica's online archive by Günther Kolar. Furthermore, the submitted documents of the awarded projects of the Ars Electronica archive were already scanned (where preserved) in Winter 2007/2008, so that these could be accessed at anytime during the activity of attributing keywords.

3.2 Implementation

Based upon the taxonomy version derived from the submission form, the attribution of keywords to the winning projects 1990-2007 for the category interactive art of the Prix Ars Electronica was implemented by the research team (Katja Kwastek, Nicole Sudhoff, and Ingrid Spörl).
The attribution of keywords was preceded by a comprehensive analysis of the individual works based on the documentation material available, which consisted of, among others, the submission form, video documentation, reproductions, sketches and work descriptions. The quality, the significance and the scope varied extremely, which made the task of assessing the work and, in particular, the interaction process more difficult. However, to a great extent the material was sufficient to arrive at keyword-relevant findings. The video documentation of the artworks which was also provided by artists was particularly helpful. Although the videos produced by the artists were very different, they usually kept certain standards of documentation of interactive works. Thus, they often contained an artist's interview or statement (description of the concept, interaction, and implementation), schematic sketches of the design as well as interactions by the artist or by visitors. Whereas some of the videos use an explanatory, spoken text (off-voice), others use text as fade-ins or subtitles.

The process of reviewing projects and attributing keywords was accompanied by regular consultations where review findings and questions regarding the principles of keyword attribution, attribution principles, meaning overlaps and categorisations were discussed. These discussions were also the basis for the definition of found keywords taking into consideration different definition approaches from the area of visual arts. These definitions are added as a separate document in ANNEX 4.

Agreement in the attribution of keywords by research team and submitting parties						
	Full agreement among evaluators in %	At least one agreement among evaluators in %	No agreement among evaluators in %	Full agreement between artists and researcher team in %	At least one agreement between artists and researcher team in %	No agreement between artists and researcher team in %
form of artwork	69	25	6	42	58	0
range of artwork	75	19	6	17	50	33
interaction partners	73	20	7	42	41	17
the visitor (performer) does	25	44	31	8	75	17
the work (project) does	19	31	50	0	42	58
media	13	87	0	0	82	18
processing technology	9	6	85	0	11	89
catchword	7	5	86	1	19	80
topic	9	36	55	0	14	86
Total agreement	**33**	**30**	**37**	**14**	**42**	**44**

3.2.1 Comparison of attribution of keywords by artists and the attribution of keywords by the research team in 2008

The comparison of attribution of keywords by the artists in 2008 and the one performed by the team of researchers highlights the existing scope of keyword attribution. The evaluation revealed that the artists' selection of keywords corresponded to a large extent to that of the research team; a full congruence of chosen keywords however only occurred rarely (14%). A quite significant part of chosen keywords did not comply with the research team's criteria (44%). At the same time, one also has to bear in mind that evaluators, too, showed some degree of difference in attributions (37 %). A full agreement was, however, achieved just as frequently (33 %). Whereas the methods of keyword attribution were reached in consultation within the research team, submitters were quite free in their individual understanding of the taxonomy's terms and of the context and scientific background against which these should be understood. Thus, discrepancies in the artists' choice of keywords were to be expected. By means of cross-checking[5] it was revealed that variances in the keywords proposed by submitters were not substantially bigger than the variances which occurred in the choices by different scientists. But even in such cases of variance, most frequently, similar terms were chosen and these were by no means contradicting. Two conclusions can be drawn from this: on the one hand, the terms which were offered could be interpreted differently despite the short definitions which were provided and there are no clear boundaries, especially with regard to aesthetic descriptions. On the other hand, artworks or their documentation can be perceived differently by different people or the focus of their perception might be on different aspects. The problem of terminological definition was met in this research project by further work on definitions, which however are explicitly to be understood as a basis for discussion and not as establishing binding settings (see ANNEX 4).

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[5] As a form of crosscheck, all winning projects of 2008 were tagged individually by Katja Kwastek and Ingrid Spörl, and the three tagging results were compared with each other.

4. Online-visualisation of indexed archive's collection

The sets of data gathered from in total almost 300 prizewinning projects of the category interactive art of the Prix Ars Electronica during the years 1990-2009 were used as a data basis for the visualisation of information. For this purpose a flash application was developed which is accessible online as an interactive version under http://vis.mediaartresearch.at. In addition, a print version of this application was presented within Ars Electronica 2009 on the poster 'Mapping the Archive: Prix Ars Electronica'. The objective of the visualisation on a formal level was to represent all artworks and the characteristics attributed to them as a data-landscape. Thus, an overview of correlations of different individual artworks and of work characteristics is provided. The visual access to otherwise not easily manageable amounts of data should make it possible to analyse and to chronologically identify developmental tendencies. Furthermore, the online visualisation represents an intuitively usable tool to simply and directly access data on individual artworks by mouse click. The conception and implementation of 'Prix Landscape Interactive Art' is managed by Evelyn Münster, key researcher of the LBI.

4.1 Clustering of keyword categories into sections

At the beginning of the visualisation project, there was the question as to how the data's order could be arranged in such a way that a transfer into a two-dimensional, schematic design becomes possible. The use of different presentation layers which are arranged consecutively, offers itself also due to the design of the taxonomy's hierarchy (Classification of keywords into categories). Consequently, the keyword categories were clustered into the sections 'formal', 'aesthetic', 'technical' und 'contextual'[6].

The following clusterings were implemented:

Clustering of keyword categories	
Section	**Keyword category**
formal	form of artwork range of artwork interaction partners
aesthetic	the visitor (performer) does the work (project) does
technical	media
contextual	catchword topic

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[6]   Cf. Katja Kwastek: Classification vs. Diversification – the value of taxonomies for new media art, in: Peter Gendolla, Jörgen Schaefer (eds.): Beyond the Screen, Bielefeld: transcript (forthcoming).

4.2 Implementation

4.2.1 Data processing

The data used for the attribution of keywords are extracted from the Ars archive's database and are stored in a separate database in a structure which is optimally suited for the application. Image data and further data files are also copied into a separate directory. Thus, the theme-landscape remains independent from the Ars archive's database and requires little storage space.

4.2.2 Graphic presentation

Five static landscapes were designed in correspondence to the four sections 'formal', 'aesthetic', 'technical' and 'contextual', with an additional view called 'overall view' which integrates all sections.
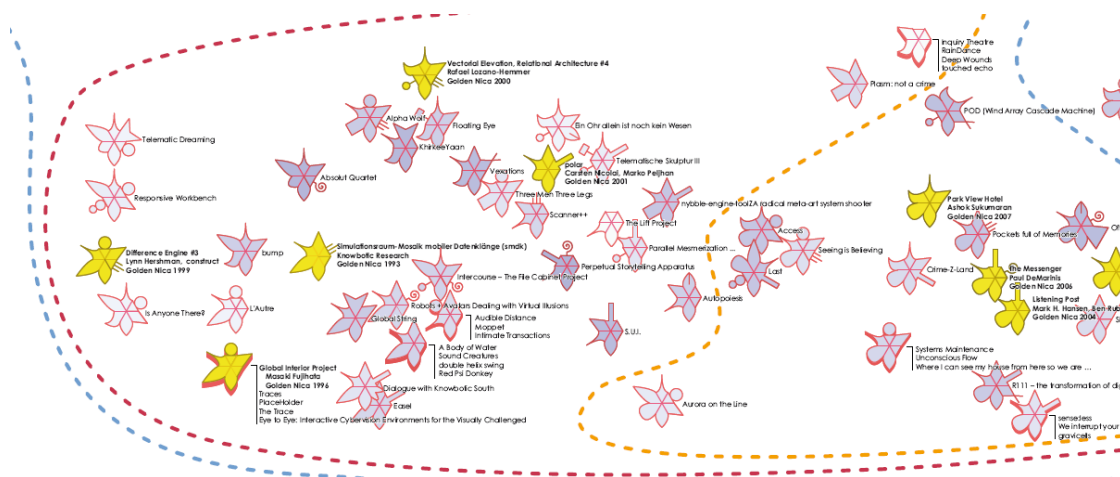Implicit similarities of the artworks which became apparent during the process of attributing keywords can now be represented in a coded form as geometric distances, in a space of similarity.
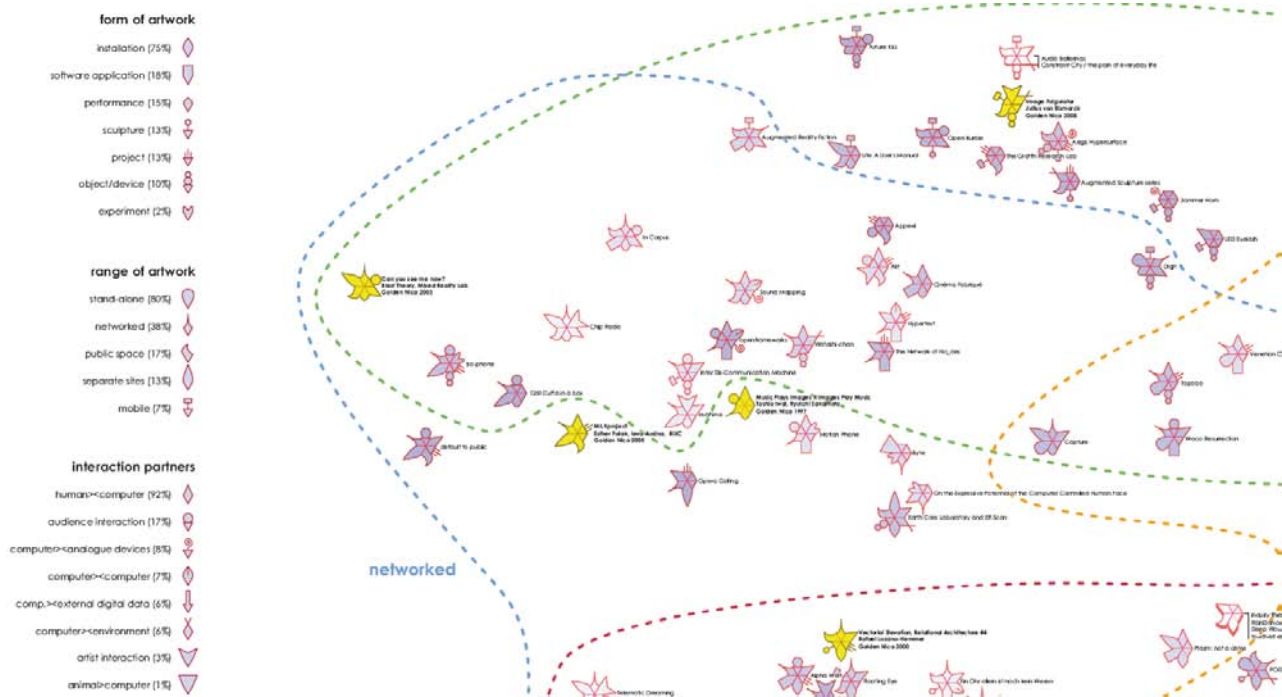Using a *Multidimensional Scaling Algorithm* (MDS), the artworks are projected as icons to a two-dimensional area in correspondence to their relative thematic congruence. This means, the more similar two works are, the closer they are located to each other. Works which showed a complete congruence in the attribution of keywords in the active section are represented as three-dimensional stacks. The terms which have been attributed are represented for each work metaphorically as petals, where each keyword is given a distinct petal form. The individual forms which thus emerge allow the spectator to easily and immediately discern differences and analogies. With a simple click of the mouse onto the work icons, further data concerning the work are displayed in a detailed view next to the landscape: Authors, description, image and date.
A legend displays the petal shapes and their respective keyword. In this legend, keywords can be activated individually, in order to highlight the projects which have been attributed to them in the theme-landscape. With a click of the mouse onto a work icon in the landscape-presentation, once again the section's keywords attributed to this work are highlighted.
It is possible to zoom into the presentation and to move zoom section.
The chronological sequence which is calculated on the basis of the year of entry is indicated by colour graduation: the older the work, the lighter its colour.

4.3 Evaluation of data visualisation

The visualisation of the keywords attributed to the prizewinning projects in the category of interactive art makes visible the correlations among the characteristics of different artworks. The four sections each show a different positioning of the artworks to each other, which allows conclusions about their existing similarities or differences within the keyword category to be made. Greater proximity of artworks represents greater similarity and vice versa. Likewise, works become apparent which hold isolated positions within one section and which therefore show fewer typical characteristics of interactive art or which cannot be classified into one group of works based on similarities. Groups become discernable, e.g. in the section 'formal': here, a significant accumulation of works from the area of 'stand-alone + installation' becomes apparent which again is subdivided into two smaller areas, the area 'sculpture + computer >< computer' and the area 'public space + audience interaction'.

5. Conclusion

5.1 Practical results

The research project taxonomy of 'interactive art' laid important foundations for media art research in several respects.

5.1.1 Providing access to the archives of Ars Electronica
The attribution of keywords to submitted projects based upon the taxonomy represents an important step towards providing access to the contents of Ars Electronica's archives. For this purpose, the keywords were directly stored in the submitters' database or the online archive's CMS.

5.1.2 Overview of developments in interactive art over the last twenty years
The data gathered through the attribution of keywords to the projects submitted to the category of 'interactive art' of the Prix Ars Electronica (all projects of the year 2007 as well as prizewinning projects from 1990 to 2009) makes it possible to come to conclusions about

developments in the area of interactive art over the last twenty years with regard to aesthetic, technical and structural characteristics.

5.1.3 Interdiscipinarity and synergies

The periods dedicated to the viewing of entries which took place in April 2007 and in March 2008, served as a platform for intense deliberations on practical and theoretical implications of a description of media art based upon taxonomies. The interdisciplinary group work of several scientists was particularly fruitful in this, as the developed terminology and classification were repeatedly queried, discussed and specified during discussions of case studies.

Furthermore, the viewing of entries in the year 2007 took place within the scope of the general viewing of entries as part of the jury's preparation of Ars Electronica. Apart from direct synergies which were generated here in the sense of a support of Ars Electronica's work and of the institute's research activities, there was an intensive exchange of views with members of staff of Ars Electronica, which promoted on both sides a better understanding of the respective work processes.

5.2 Research results

5.2.1 Overview over state of research

The survey of existing classification initiatives and the theoretical perspectives on the topics which are provided in the first part of this research report offer a good overview of the current state of research but it also shows clearly the situation which results from a lack of scientific methodology and which is characterised by a lack of description standards.

5.2.2 Methodological discussion of the benefit of taxonomies

The taxonomy which has been developed does not only serve as a basis for the structuring of data, but it also makes the diverse scientific perspectives on interactive art as well as the range of variation of works described as such conceptually conceivable. The findings with regard to these aspects are exemplified in a few points in the following.

5.3. Discussion

5.3.1 Necessity of flexibility

It became clear that not only the work process itself but also the keyword systems resulting from it require a high degree of flexibility. Thus, it was shown on the one hand, that working on terminology only makes sense as work in progress, in order to allow for new findings to be integrated continuously into the research design during the course of the research project. This means on the other hand, that the development of a normative taxonomy which once completed becomes mandatory would neither do justice to the artworks nor to the research work. This fact represents a complex problem from an information technology perspective: for the time being, there exist at least three different versions of the taxonomy in this project (keyword attribution 2007, attribution of keywords by the artists 2008/2009, retrospective attribution of keywords 1990-2009). These taxonomies are to a large extent but by no means completely identical. The fact that in the scope of the artists' attribution of keywords, own keywords could be added, led to a significant quantitative increase of keywords in particular. To portray the historic development of an already complex indexing system through data-processing would, however, require extremely complex data management. Although such a project appears to be highly interesting from a history of science perspective, this has to be weighed against the question whether presentations of this kind would not strongly impede the system's general user friendliness and performance.

5.2.2 Limits of a terminological definition

Generally it became clear in our work, that a distinct terminological definition is impossible in the area of artistic projects and that this could even be counter-productive. Especially in the field of aesthetic terms, one will always encounter different connotations which are context and user dependent. Also, it is not possible to clarify for individual cases whether a term was used metaphorically or literally. If, for example, the term of 'surveillance' is used in a project, then this use does not clarify its importance within the project or how obvious and intended this process is in reality. Thus, CCTV can be used for purposes of simple representation of a piece of uninhabited nature and it is then a question of interpretation whether such a process is

distinctly described through the term of surveillance. Whenever the aim is to provide an interpretive description of an individual work, then a contextual description will usually be superior. However, even for this purpose, the development of a terminology as approximation seems to be extremely helpful, as only a differentiated vocabulary allows for a differentiated description of individual works. For that purpose, one will have to accept that individually selected keywords might be controversial.

5.2.3 Evaluation of collected data

The data gathered for the taxonomy's system of keyword attribution, form the starting point for qualitative analysis. The attribution of keywords as well as jury statements on referring to the laudation of prize-winners provide information about the establishment of genre-specific terms and about specialties of artistic work in this area.

As no adoptable analysis standards have so far been developed for the area of interactive art, the development of an approach of choice is just as important as the data collection itself. The evaluations presented so far therefore do not represent definitively approved results but rather observations of tendencies. They confirm or negate previously established hypotheses and raise new ones.

The objective of attributing keywords which is the differentiation of the heterogeneous field of the art form described as 'interactive art' and the more detailed description of its aesthetic, technical and structural characteristics could not be fully reached at the completion of the second research phase.

An analysis of collected data with regard to the chronological distribution of keywords, but also the association of works to specific countries or specific artists could lead to new findings on the development of foci of this field of interactive art. For this, one obviously has to bear in mind that the annual 15 prizewinning projects of Ars Electronica cannot be considered to be representative for this very heterogeneous field of art, but they still represent an interesting collection, which provides interesting findings when compared.

The following questions emerged and could be pursued in a further research project: chronological distribution of keywords, overlaps and differences of work characteristics within one group of keywords, differentiation and further development of the thesaurus (additions to categories based upon artists' proposals, clustering of keywords).

5.2.4 Visualisation

With regard to a further evaluation, visualisation represents an important tool. The theme-landscape which has been implemented offers a very interesting overview of all prizewinning projects and their attributed keywords and of their characterisation. A vast multitude of comparisons from different scientific perspectives become possible. At the time of the drafting of this report, work on a second visualisation is ongoing which juxtaposes the presentation in a theme-landscape which focuses on the contextualisation of the overall context to a visualisation with possibilities of combined search, in the sense of a facet search.[7]

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[7] See http://vis.mediaartresearch.at/webarchive/public/view/mid:36

ANNEX 1: Statistic attribution of keywords to all submissions 2007

The following statistics show the attribution of keywords according to the first draft of the taxonomy of all submissions to the Prix Ars Electronica in the category of 'interactive art' for the year 2007. These attributions were given by Katja Kwastek, Ingrid Spörl and Heike Helfert.

Keywords category	Keyword	Number
form	installation	229
	sound installation	14
	sculpture	44
	object	25
	performance	30
	experiment	9
	software-application/program	43
	net art	24
	other	5
range	stand-alone	270
	public space	30
	separate sites	14
	mobile	10
	networked internet	53
	networked wireless	16
	networked LAN	9
	networked telephone network	11
	other	5
interaction	human >< human (mediated by computer)	34
	human >< human (not mediated by	7
	human >< computer	283
	bodily functions >< computer	10
	environment >< computer	17
	external digital data >< computer	9
	computer >< analog device	6
	computer >< computer	7
	none	26
	other	3
type of interaction	observation	23
	exploration	61
	activation	147
	control	102
	selection	27
	navigation	19
	participation	34
	co-authoring	9
	communication	14
	collaboration	13
	none	20
	other	5
topic/strategy	surveillance	19
	instrument/tool	64
	trade/exchange	2
	narration	34

	documentation	16
	perception	28
	game	32
	communication	37
	visualization	56
	sonification	22
	metamorphosis	23
	memory/storage	9
	immersion	11
	cybernetic/closed system	6
	interface design	41
	other	47
input device	sensors (infrared, optical, thermic etc.)	77
	electromagnetic frequency sensor/receiver	7
	video camera	92
	infrared-camera	5
	photographic camera	6
	light emitting device	3
	scanner	2
	microphone	30
	cell phone (SMS)	5
	cell phone (other)	10
	telephone	3
	handheld device (e.g. PDA)	2
	keyboard	35
	graphical interface (mouse)	39
	graphical interface (trackball)	5
	graphical interface (touchscreen)	4
	graphical interface (touchpad)	1
	joystick / console	15
	data glove	1
	tangible interfaces	31
	organic interfaces	2
	switches /electronic input devices	10
	GPS-device	2
	smart card	2
	barcode	2
	marker tracking system	1
	RFID	8
	other	62
processing-technology	motion capture	81
	voice recognition	8
	text recognition	4
	chroma-keying	3
	eye-tracking	3
	image capture	8
	biometric identification	1
	bio-feedback	4
	custom	85
	other	96
	none	13

output-technology	video	102
	projection	161
	monitor/LCD screen	91
	TV	6
	computer-graphics/animation	142
	still image	23
	VR (Cave, HMD, other)	4
	light	28
	printer	5
	sound (acoustic)	53
	sound (electronic)	110
	sound (headphones)	4
	broadcast-radio	2
	cell phone (other)	4
	cell phone (SMS)	2
	telephone	3
	handheld device	3
	motors (e.g. robotics)	32
	other	20
technical character	locative media	4
	augmented reality	11
	ubiquitous/pervasive computing	31
	virtual reality	13
	telepresence	11
	artificial intelligence	6
	low-tech	13
	media archaeology	11
	interactive cinema	2

ANNEX 2: Implementation of the taxonomy 2008

In the following, the entry form documents show how submitting artists were given the option to attribute keywords online since 2008. Note regarding the implementation: Explanations in parenthesis remain behind the terms; explanations in square brackets are available as mouse-hover text.

Entry form

Please take some minutes to select keywords for your project.
If necessary, you can also add new keywords. Up to three keywords can be selected in each category (except the category media: no limitation). To add a new keyword, type it into the form and hit enter.
For some categories, additional information on the terms is available as mouse-hover text.
The collection of keywords is a joined project by Ars Electronica and the Ludwig Boltzmann Institute Media.Art.Research. It is an attempt to enhance the usability of the Ars Electronica Archive and to develop a vocabulary for the description of media arts.
For further information see http://media.lbg.ac.at/de/content.php?iMenuID=67
Your comments and suggestions are welcome: forschung@media.lbg.ac.at

form of artwork
• installation
• sculpture
• object
• performance
• software application/program

range of artwork
• stand-alone
• public space
• separate sites
• mobile
• networked
• virtual worlds (e.g. Second Life)

interaction partners
• human><human (artist interaction)
• human><human (audience interaction)
• human><computer
• computer><computer
• computer><external digital data
• computer><environment
• computer><analogue devices

the visitor (performer) does
• observe [the participant can observe the work without interacting]
• explore [the participant can explore the work]
• activate [the participant can activate the work or parts of it]
• control [the participant can control the work]
• select [the participant can select items/actions]
• navigate [the participant can navigate within the work]
• participate [the participant can participate in the work]
• leave traces [the participant can leave traces or store information]
• co-author [the participant becomes a co-author of the work]
• exchange information [participants can exchange information]

the work (project) does
• monitor [the project monitors data or persons, e.g. using surveillance technology]
• serve as an instrument [the project serves as a tool or instrument]
• tell, narrate [the project tells a story]
• document [the project documents events, actions or processes]
• enhance perception [the project aims at enhancing perception]
• offer a game [the project is designed as a game]
• enable communication [the project enables communication situations, networks or broadcasting channels]
• visualize [the project translates data or processes into image, graphics, animations]
• sonificate [the project translates data or processes into sound]
• transform [the project transforms or modifies elements/processes/data]
• store [the project stores or gathers data]
• immerse [the project enables immersive experiences]
• process [the project internally processes data, e.g. in cybernetic/closed systems]
• mediate [the project mediates processes, e.g. within the scope of interface design]

media
- video
- computer graphics/animation
- still image
- projection
- monitor/screen
- 3D (VR, HMD, CAVE, other)
- sound acoustic
- sound electronic
- head/earphones
- speakers
- broadcast media (radio/TV)
- (cell-)phone
- handheld device
- light
- sensors (infrared, thermic, optical, electromagnetic)
- video camera (also infrared)
- photographic camera
- keyboard
- graphical interfaces (mouse/trackball/touchscreen, etc.)
- joystick/game controller
- tangible interfaces
- switches and other electronic input devices
- GPS device
- microphone
- RFID
- motors (e.g. cybernetics/robotics)

processing technology
- motion capture
- image capture
- voice recognition
- text recognition
- chroma-keying
- eye-tracking
- bio-feedback
- custom
- none

catchword
- locative media
- augmented reality
- ubiquitous/pervasive computing
- virtual reality
- telepresence
- artificial intelligence
- low-tech
- media archaeology
- interactive cinema
- ubiquitous/pervasive gaming
- wearable computing
- cybernetics

topic
- artificial life
- artificial intelligence
- biographies
- economic systems
- environment
- everyday issues
- evolution
- genetics
- mass media
- media
- migration
- online worlds
- politics
- religion
- social relations
- privacy

ANNEX 3: New proposals made by submitting parties in 2008 (spelling as made by submitters)

form of artwork	range of artwork	interaction partners	the visitor/performer does	the work/project does
architecture choreographic environment concert custom HID cybernetic model dance and live images Fictitious Political Party hybrid game sculpture interactive audio light installation interactive cinema interactive video live drawing with interactive movement and sound media installation Net art online Painting-Sound or Information procedural storytelling process public art site specific sound-sculpture touchscreen monitor video videogame Virtual Reality visible music wall installation	6 computer controlled videos Crossing Boundaries dark sites digital reality education Exhibition room fine art interactive experiment with multiple facets and related exhibition and lectures live cinema locative media Needs its own space networked on the WEB object based interactive art work one-on-one online media onstage parasitic participatory networked installation performance or gallery space performed sites can be telematically connected or in the same area television and/or broadband internet theatre presentation visible music	asynchronous human audience to video audio triggers can work with multiple participants cloth computer - robotic haptic interfaces computer-external device computer-gt;human data to computer to video human - computer - analog devices - computer - human human via buffer human-machine-environment human<>computer (audience interaction) human><analog devices human><analog devices><computer><environment human><audio light space (audience interaction) human><computer><human human><data human><digital nature human><human (mirror) human><motion sensors human><objects human><sculpture human><search engine><accessible data human><space interactive screen object><human self observation video database network communication with participant	archive consume! converse design experience is augmented learn listen marry paint performs physical music play music search subvert touch trigger sounds visitor is the mottor watch and hear	activate allow visitors to send and read text contributions on rendition flight paths circumvent create an interaction within the public create digital puppets create nonsense poetry de-enhance perception drawing entertain facilitate public discussion generate sounds generate interact intervene provokes awareness provoks remind subvert track the public transform dance in video abstract forms Transform to tactile sensation wed someone (jemaden verheiraten)

Continuation:

Media	processing technology	catchword	topic
a singing tree that is interactive	3DOF Tracker	Airport art	activism
bone conduction	5D matrix of data	algorithmic	algorithmic
book	accelerometer I2C network	ambisonics	Analog-Digital
camera	acoustic controlled	Analog-Digital	and bigger chains linked together
coloured light	analog switch	artificial communication	and bigger things
console	Arduino microcontroller and Max/MSP	audio-visual	and their environment.
custom electronics	software	Betamax of Life	art
custom mirror	Arduino	communication	Artificial nature
Firefox extension	audio analysis	computer music	artificial personality
floor based 8 x 6 Metre responsive	audio broadcast	de-augmented reality	attention to self
installation	audio capture	digital interior design	behaviour
human body	biometric comparison	digital reality	body
human interface devices	colour composition	distributed audio network	brain science/cognitive psychology
illumination	Colour	drawing	brainwaves
Infrared Ray	custom software; hardware	e-culture	cell biology
interactive objects	eye-tracking	emotion computing/mind reading technology	censorship
interactive strings	face recognition	emotional computing	children
interactive light installations	face-tracking and face-analysis	feedback	Chinese characters and phases
lasers & fibre optics	Fast Fourier Transformation	fiducial marker dance	collaborative effort
light sensible sculpture	finger position sensing	Fluidity	console
light-sound installation	generative	game	consumerism
Lights	geo-localization	Generation	Contact highlights the results of peoples
live drawing and contemporary Butoh	haptic interfaces	geospatial storytelling	interactions with each other
low resolution lightpixel-screen	haptic sensing	guerilla media	control of public and pirate space in network
Meat	I2C accelerometer network	harmful	society
mechanic	image processing	human/machine loop	copyright
mechanical projection machine	image recognition	hyperstereo video	cosmic world
mechanism	infrared light	identity	critique
micro controller motion sensors LEDs	innovative in-house interface	immersive environment	digital reality
mobile surround sound	IR sensors	immersive gaming	dynamics
Mobile-SMS	Java explore	immersive responsive environment	education
oled	Light barrier	information architecture	Embodied Interaction
original one	light capture	interactive dance	Endangered Birds
physical object	live image	interactive dark musical comedy	experience
POV display	locative calculation	interactive machine	experience/phenomenology
self-developed sculptural objects	Max MSP Jitter	interactive movement broadcast technology	folklore
sensor	mechanic	interactive robotic music	fun
superterrestic light	Metasearch Engine	interactive sculpture	game
tactile screen	motion and colour detection	interactive sound collage	gender/age politics
tangible input	motion and proximity sensing	interactive swarm	Habeas Corpus
Text-To-Speech	motion recognition at various	interactive synaesthesia	herstories
textiles	distances	interactive video installation	history of human-machine-interaction
thermic printed fortunes	motion sensing	interactive video	history
Touch Screen Computer Screen	motion visualization	Interactive Water and image Fountain Clock	human relationship - multimodal interface
touchscreen	movement recognition	intercultural mirror	illusionary space
water	movements tracking by video	Japanese perspective	image recognition

Media	processing technology	catchword	topic
weaving webmail service wireless interaction	On-line interaction original machine position capture pressure sensor real time GPS position recognition real-time Non Photo realistic rendering recursive database rfid database RFID detection select song and press play semi-acoustic sensitive space(sensors) sensor shape-analysis solenoid switch sound layering sound(volume and pitch) analysis speech synthesis tilt sensor tracking system and computer graphics understanding cinematic editing rules using in-house NextText library (www.nexttext.net). using in-house NextText library for text visualisation (www.nexttext.net) vibration recognition visual data transformation (X-Motion) voice capture/sensor data capture voice recording voice synthesis voltage range inverter volume recognition Wii remote controller wireless communication XML Database export	japonaiserie light sensible sculpture literature live cinema mediated presence through physical objects musical performing instrument for digital age narrative novel interfaces open game situation optical interaction Physical Immersive Environment real life gaming reconstruction reflective media relational responsive installation science-fiction x non-fiction semi-acoustic instrument Sensorial Provocation sitespecific social games social interaction with machine social software software art sound installation sound-art surveillance synergetic environment talking machine tangible interaction Transformation video artgame	images Immersion immersive experience immersive systems instinctive reaction interactive environment interactive generative interface kinetics knowledge arts language per se learning life information life on the planet life presence light man-machine symbiosis media interventions meditation memory and architecture memory database memory mirror illusion moods multicultural environment natural environment nature & artifices networked torture perception personal mythology philosophy physical engagement / body extension physical interplay play poem(Japanese tanka) poetry post interactive psychology public blogs Science Theory self awareness self-fulfilling prophecy self simulation situationist social intelligence social theatre

Media	processing technology	catchword	topic
			sound design
			speech
			sports
			storytelling
			substantial media alphabetization
			synergetic
			system as artwork
			Tactile
			tactility
			temporal awareness
			The fusion of science art and technology.
			time-travel drama; subjectivity
			urban sphere
			utopia
			vibration
			video game
			visual intelligence
			visual perception
			vulnerability and politics of life
			western art history
			women_s studies

ANNEX 4: Definitions

Ingrid Spörl, 2009

Preliminary note: These definitions could only be established as first proposals within the framework of the research project's duration.

The following definitions organise the keywords proposed in the taxonomy in a terminological reference system. These definitions were preceded by methodological studies of interactive projects of media art and their descriptions. On the one hand, all projects which had been nominated for the category of interactive art of the Prix Ars Electronica were reviewed again, and, on the other hand, the attempts of different institutions of media art to categorize the terminology were evaluated.

The proposals for definitions refer to established meanings of terms from the context of contemporary art. This is particularly true for the first category. However, they put the focus on the area of technology and new media claimed by interactive art. Etymological derivations are only of limited importance in this context. The definitions describe detailed criteria to facilitate the attribution of keywords to artworks.

Two categories of the taxonomy are not explained by definitions. The category 'media' refers to the enumeration of well known input- and output devices. Keywords of the category 'topic' depict key topics of interactive artworks. The key topics proposed in the taxonomy only represent an excerpt of possible questions as regards context. A reduction of the content's diversity to one agenda of topics was to be prevented. For this reason, we abstain at this point from the definition of keywords of the category 'topic'.

Keyword category 'form of artwork'
This classification under keywords represents an approximation to the artworks from an art history perspective. In the context of media art, it makes sense to have a broader understanding of these classifying terms and to possibly choose a definition which deviates from conventional understanding. This category provides an overview over the physical condition of the artworks, e.g. with regard to their performing or immaterial character.

installation
The term installation is used in contemporary art history for a multitude of artistic works which relate to the space encompassing them as three-dimensional work formations.[8] The installation's local mode of action stretches into the spectators' space.[9] In this, interactive installations differ from the artforms *sculpture, object, project and experiment.* Interactive environments[10] too, are also classified under the term of installation – in contrast to Söke Dinkla's[11] differentiation. They constitute the space of action for a performing interaction between the artwork and the spectator. The selection and the layout of physical components of interactive installations are substantially shaped by the technical conditions necessary for the interaction.

sculpture
Within the scope of the taxonomy proposed here, the term 'sculpture' describes a three-dimensional object of variable size which is not necessarily bound to a specific place. An interactive sculpture can be mobile or can move like a robot. It has a self-contained structure which consists of one piece and which is reduced to the sculpture's body.

object/device

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[8]   The reference to the spatial environment is often given by the installation's duration and it can be repeated at other locations. In its state of presentation, the installation is immovable but not necessarily location-dependent. See: Johannes Stahls Beitrag *Installation* in: Butin, Hubertus (Ed.): *DuMonts Begriffslexikon zur zeitgenössischen Kunst*, DuMont Literatur und Kunst Verlag, Cologne 2002; pp. 122

[9]   Stahl, Johannes: *Installation* in: Butin, Hubertus (Ed.): *DuMonts Begriffslexikon zur zeitgenössischen Kunst*, DuMont Literatur und Kunst Verlag, Cologne 2002; p. 125

[10]   Here, the understanding of the environment was not to be reduced to an art form with a closed and illusionist design of space; cf. Stahl, Johannes in: Butin, p. 124

[11]   Cf. Dinkla, Söke: Pioniere Interaktiver Kunst, Cantz Verlag, 1997, p. 36

Here, all interactive artworks are described as objects/devices which by their form look like devices available in retail. They are portable and mobile. Their structure is comparable to a sculpture's one, i.e. three-dimensional, of one piece and self-contained. In contrast to the latter however, they fulfil a purpose, are often handy, intended for mobile use, and therefore they are also identifiable as design-object interface, instrument or tool.

performance
The interactive performance comprises different facets of performing art. This can involve a performance in front of an audience in an interactive environment, spectators' activities or a performing situation between the artist and the spectator. In contrast to RoseLee Goldberg's opinion, it can also have a preliminarily defined sequence[12]. Usually, the interactive performance is embedded in a specific technical setup and is therefore limited by the performance's durations.
The materiality of the technical setup can vary significantly. It can have an object-like or installation-like character, and it might also allow a presentation of the artwork as an installation with spectator interaction within the exhibition context. In such cases, an artwork can range from installation to object or sculpture and to performance.

primary software application/program
The works' character in this category is mainly to be understood immaterially. The software or the programme is an independent, self-contained systemic unit (e.g. computer game, DVD/CD-ROM-project or a specific algorithm). The artwork presents itself as a system which, for example, structures data via hypertext functions or which offers virtual game worlds. The presentation media are non-specific, often using standard interfaces which usually are exchangeable. In other cases, the software is combined with other forms of art such as performance or installation.

experiment
For an interactive artwork which has a form described as experiment, the scientific discourse is the central motive with regard to form or content. The experimental artwork is unfinished. Artworks which are categorised as experiments can imitate the setup of a scientific test series by using materials such as measuring devices, special testing tools and data display. Very often, the artist herself/himself already refers to the artwork as an experiment, test series or pilot project. Regardless of the spatial setup, the artwork is only classified as an experiment in this taxonomy, if the thesis treated by the artwork is open-ended. It is in particular this feature which differentiates the experiment from a project which usually has an intended and controlled result. The common description (catchword) 'artistic research' often applies to experiments.

project
Works which do not have a concrete technical manifestation as they represent collaborative or concept-based works which become concrete via different media or events are described as projects. These works include socio-cultural projects, group works, workshops, research projects and the like. Furthermore, non-completed work series or individual artworks which are under development are also included. In such cases, a combination with keywords such as installation best describes the artwork. The development of an innovative interface design can also be termed as project, insofar as the conceptual relation is not of a performing, experimental, sculptural or installation character.

Keyword category 'range of artwork'
A special character of an interactive artwork consists in the artwork being based on mutual relations.
The category 'range of artwork' describes the spatial sphere of reference in which the interaction takes place.

stand-alone

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[12] See Butin; p. 241

Artworks for which the keyword stand-alone (autonomous, freestanding) applies, are location-bound installations and sculptures. An important feature of stand-alone artworks is the generation of the input and output of interaction at one and the same location. Objects can also function as stand-alone objects and then they are not necessarily location-bound but can possibly be portable or mobile.

public space
This keyword is used for all artworks (installation, sculpture, object, performance, experiment, project), which are shown in the public space or the interaction of which takes place in public space.

separate sites
The keyword 'separate sites' applies to installations, experiments, performances, software applications and projects in which the interaction is spread over separate rooms or locations.

mobile
Mobile applies to objects which are not bound to one location but which can cause interaction at any location. Consequently, an installation cannot be mobile.

networked
The artwork has a networked status, once interaction happens via internet, wireless networks (e.g. radio, satellite, mobile phone) or other non-internet based links (e.g. intranet, telephone). Typical networked interactive artworks are works which generate tele-presence, collaborative, internet-controlled installations or GPS-based works.

Keyword category 'interaction partners'
Each interactive artwork creates situations which allow for and require mutual (re-)action among systems. The systems which are part of this interrelation are identified as interaction partners. These systems do not necessarily have to be persons (artists, performers, participants), but can obviously also be complex technical systems with interaction-capability (computer, machine, equipment).

human><human (artist interaction)
Interaction takes place between the participant and the artist/performer and is conveyed via a technological system (computer, machine, equipment).

human><human (audience interaction)
Interaction takes place among participants in a way which is or is not conveyed by a technological system (computer, machine, equipment).

human><computer
The interaction takes place between a technological system (computer, machine, equipment) and the artist/performer or the participant.

computer><computer
The interaction only takes place between technological systems (computer, machine, equipment).

computer><external digital data
The interaction takes place between the technological system (computer, machine, equipment) and the reception or the automated entry of digital data (measured values, analysis results, counting, data generated by digital processes, body function measurements).

computer><environment
The interaction takes place between the technological system (computer, machine, equipment) and its surroundings/environment/surrounding space.

computer><analog devices
The interaction takes place between simple devices/objects (e.g. household appliances) and technological systems (computer, machine, equipment).

animal ><computer
The interaction takes place between a technological system (computer, machine, equipment) and animals.

Keyword category 'the performer (visitor) does'
The terms of this category describe the participant's/performer's options for interaction with the artwork. In order to more precisely describe the directional intention of the action and its subject, these keywords are worded as verbs.

observe
The observer is not actively involved in the interaction process, but observes this process or observes the artwork. A combination with other keywords of this category which describe an observer's/performer's active role, should be excluded.

explore
The observer/participant is actively involved in the interaction processes which are made possible by the artwork. However, the action is limited to non-targeted exploration and discovery.

activate
The observer's/participant's active role is limited to the activation of a process. The activation can be done purposefully via the operation of a simple interface according to the principle of a switch or unconsciously via sensory interfaces.

control
The observer/participant/performer can control processes and their results via interfaces (e.g. joystick, sensors).

select
The observer's/participant's active performance is limited to the selection of preset options. The selection specifically relates to contents or processes. The sequence of selected processes can sometimes simulate actions such as controlling and navigation.

participate
In this taxonomy, an observer's/participant's participation is assumed once the observer/participant adds data to the process (e.g. text, images, the sound of the voice, etc.) and temporarily changes the processes' result in an unprecedented way.

navigate
Navigation represents a category of activity which goes beyond activation, control and selection. The observer/participant performs a targeted movement within information structures or virtual worlds. The space of navigation in this context is mostly immaterial or to be understood as structural metaphor (hypertext structures).

leave traces
The observer/participant/performer changes the artwork permanently through his interaction by adding or modifying contents, however without influencing its structure or interaction processes.

co-author
The observer/participant permanently changes the artwork's structure and processes through his action and thus becomes jointly responsible for its conception and design.

collaborate
The interaction process is determined by the collaboration of several observers/participants.

exchange information
The observer/participant exchanges information with other observers/participants through a communicative act (mostly verbal or visual).

create

The observer/participant generates a (mostly visual and/or audible) result by means of the artwork.

Keyword category 'the work (project) does'
Terms of this category describe the processes relevant for interaction, either as a function of the artwork or as a productive act. Here again, keywords are worded as verbs, thereby assigning the role of executing subject to the artwork.

monitor
Through technological procedures and interfaces, observers/participants/performers, objects or environments are recorded. A conscious intervention by the observer/participant/performer is not intended.

serve as an instrument/tool
The artwork can be considered to be an instrument or tool.

tell, narrate
The process of interaction conveys a fictitious story through language, text or images.

document
As a result of the interaction process, facts and information are conveyed by language, text or images.

enhance perception
The artwork allows the observer/participant/performer to experience an intensified perception, exceeding natural perception, by means of specific procedures (e.g. immersion or tele-presence generating presentations).

offer a game
The observer/participant/performer is involved in a game[13], i.e. an interactive process with clearly defined rules and a predetermined goal.

enable communication
The artwork creates a communication situation and produces the technical preconditions to allow for interaction in the form of communication.

visualize
The information structure of movement, sound or other parameters is translated into image information (e.g. video, graphics, colour). The transformation is happening completely systematically and according to fixed rules so that input and output correspond. The act of making processes and reactions visible is here not described as visualization, since a translation effort is required.

sonificate
Movement, images, colour or other parameters or an information structure are translated into sound.
The transformation takes place according to defined rules, so that input and output do indeed correspond.[14] The fact of making processes and reactions audible is here not described as sonification, since a translation effort is required.

transform
The original data are modified by a technical process and are reproduced in their altered form.

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[13]   Cf. Galloway, Alexander R.: *Gaming – Essays on Algorithmic Culture*, University of Minnesota Press, 2006, p. 1
[14]   See: Hermann, Thomas: *Daten hören* in: Schulze, Holger (Hg.): *Sound Studies: Tradition – Methoden – Desiderate*, transcript Publishing house 2008, p. 211

store
Data which are incoming during the interaction process are stored. The artwork represents a collection, an archive or a database.

immerse
By means of special display methods (3-D, CAVE, HMD), the artwork generates an immersive experience for the observer/participant/performer, i.e. a state of immersion into an artificial world.

process
The artwork is based upon a self-contained data processing activity, without the observer's input. Typical examples are cybernetic works or closed systems.

mediate
The artwork conveys or illustrates something, without executing a complex data processing process.

Keyword category 'catchword'
In the discourse on interactive media art, specific terms were established during the exchange among artists and scientists, which often represent mixed forms between technical descriptions and technological or societal visions. A selection of keywords which are most relevant for the classification of interactive works is included in this taxonomy.

locative media
The artwork is based on a system which uses the performer's/user's geographical position as data input or output. GPS (Global Positioning System) or mobile devices such as mobile phones, laptops or PDAs (Personal Digital Assistant) are used for the purpose of position finding.

augmented reality
Objects, locations or situations are replenished by virtual image information in real time so that the perception of the natural environment is supplemented by those virtual elements.[15]

ubiquitous/pervasive computing
The term *Pervasive Computing* describes the omnipresent penetration of our everyday life by 'intelligent' devices and equipment as well as their networking capabilities. Whereas the adjective pervasive stresses the immaterial character of information transmission which then makes it possible to overcome material obstacles, the term *Ubiquitous Computing* focuses on the omnipresence of computer-based information processing e.g. via micro electronics.[16]

ubiquitous/pervasive gaming
The terms *ubiquitous* or *pervasive gaming* are used to describe computer-based games which reach out into the gamer's everyday environment and into public space. An overlap of real and performed activities occurs.

virtual reality
Virtual reality generally refers to computer-simulated reality.[17]
Principal technologies for the generation of VR are visual 3-D-modelling procedures. Typical technical interfaces which are used for transmission are head-mounted-displays, data gloves, data suits and others.[18]

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[15]   Cf. Cotton, Bob/Oliver, Richard: The cyberspace lexikon; Phaidon Press Ltd London 1994
[16]   Cf. ibid. as well as: Weiser, Mark (1991): The computer for the 21st century, Online available under: http://www.ubiq.com/hypertext/weiser/SciAmDraft3.html (As at 01.07.2009)
[17]   Cf. Wirths, Axel (Ed.): *Der elektronische Raum – 15 Positionen zur Medienkunst*; Hatje Cantz publishing house, Ostfildern 1998, p. 231
[18]   Cf. Cotton, Bob/Oliver, Richard: The cyberspace lexikon; Phaidon Press Ltd London 1994, p. 209

telepresence
Telepresence describes an impression generated by technical processes of being at a far removed location or of meeting a far away person. Often, a form of activity is made possible at this distant place or together with a person at a far away location.[19]

artificial intelligence
Systems which can simulate human capabilities such as perception, reaction to the environment, learning and coming to a logical conclusion and which use complex software algorithms to do so.[20]

low-tech
In the context of media technologies, this term is used to characterize purposefully simple everyday or analog technologies. Typical artworks of this type are generated in tinkerer or hacker environments.

media archaeology
Media archaeology is described as a non historicizing understanding of media in the sense of their operative entanglement of logic and matter.[21] An anachronistic use of technologies and media in artistic works thematically alludes to the mutual relativity of technological and intellectual development.

interactive cinema
A film concept which allows the spectator to have an impact on the narrative happening during its course, often by selecting options.[22]

wearable computing
The use of digital technologies and devices in clothing for the functional use on the human body.[23]

cybernetics
Cybernetics researches the principal concepts for the control and regulation of systems.[24] Machines, organisms, society and the human being are all understood as systems – cybernetic art studies the borderline between human being and machine or it does something to dissolve these boundaries. In interactive art, the term cybernetics is mostly used for artworks whose concept is based on the logics of closed-loop control circuits of self-regulating systems. (Among other things closed-circuit, closed systems).

kinetics
The use of mobile, often also mechanic equipment. Software only plays a minor role in artworks of this category.

robotics
Electro-mechanic devices which are equipped with programmable micro-computers and which can execute increasingly independent and complex activities are called robots.[25] In the context of interactive art robotics refers to most equipment with digitally or electronically controllable mechanic elements.

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[19]   Cf. Wirths; p. 231
[20]   Cf. Cotton; p. 15
[21]   Different authors: *Online-Glossary* (2008)
http://www.keshma.net/doku.php/research:glossary:medienarchaeologie (As at 3.07.2009)
[22]   Cf. 'Interactive Movie' in Cotton; p. 112
[23]   Cf. 'Wearable Computer' in Cotton; p. 215
[24]   Cf. Cotton; p. 56
[25]   Cf. Cotton; p. 175

artistic research
Artistic research is pursued in experimental, project-oriented works. A close collaboration of scientists representing different disciplines or the use of scientific or pseudo-scientific methods and/or equipment is characteristic for these projects. The proximity to science does not only play an important role for the technical implementation but is of particular conceptual importance. The artwork presents itself formally as work in progress in its developmental stage reached to date, but it projects its conceptual perfection and the development of its potential into the future.

embodiment
In contrast to the understanding of this term as materialisation or presentation[26] of something, embodiment in the context of media art describes the inclusion of the participant/performer. In this, the human body is addressed in its sensual and active function in which it turns into the interface between consciousness and interactive work[27].

closed circuit
Closed circuit also means 'closed loop' or 'feedback'. In the context of media art, this term describes the use of output as input. Often, this principle is used in the form of closed-circuit video installations in which the produced video image presented in real-time is again recorded.[28]

interface design
Interface design designates the design of interfaces and user interfaces between human beings and technological systems. It aims at optimizing the conditions for human interaction and at minimizing obstacles in the mutual exchange of information.[29]

Hypertext/-media
Hypertext describes the non-linear structuring of text in the digital medium in which individual text components are linked to each other or are referring to each other. *Hypermedia* combines different digital contents such as text, image and sound and networks these according to hypertext principles.[30]

Keyword category 'processing technology'
In many interactive works, highly specialised technological interfaces are used which serve to recognize and evaluate information such as movement, text or sound. The use of such a recognition method is often linked to a specific work layout; they often have a typical work structure in common. Not all possible methods are offered as a keyword, but only the most important and most frequently used technologies of artistic practice.[31]

motion capture
Movements of participants/ performers are recorded and evaluated in real-time via sensors (visual, thermal, acoustic, mechanic, etc.) and technological methods in order to obtain information (position, velocity and direction of movement) for the artwork's reaction.

image capture
Digital image products (pictures of participants, objects, video stream) are transmitted to the artwork's technological system in real-time, which are however neither analyzed nor processed.

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[26] The authors Franchi and Güzeldere explain for example embodiment in the context of early sensational attempts of artificial intelligence as physical realization/embodiment of intellectual effort. Cf. Franchi, Stefano/Güven Güzeldere: Mechanical Bodies, Computational Minds; The MIT Press, Massachusetts 2005; p. 36

[27] Cf. Crowther, Paul: *Art and Embodiment - from aesthetics to self-consciousness*, Oxford University Press New York, 1993

[28] Slavko Kacunko provides a differentiated discussion of closed circuit, see: Kacunko, Slavko: *Closed Circuit Videoinstallationen*, Logos Publishing house, Berlin, 2004; p. 87

[29] See Sommerer, Christa/Mignonneau, Laurent/King, Dorothée (Eds.): *Interface Cultures*; p. 9

[30] Cf. Cotton; S. 98

[31] See: Katja Kwastek: Classification vs. Diversification – the value of taxonomies for new media art, in: Peter Gendolla, Jörgen Schaefer (eds.): Beyond the Screen, Bielefeld: transcript (forthcoming).

voice recognition
The participants'/performers' vocal utterances are recorded via microphone and are analyzed for voice characteristics. Individual voices and even linguistic units of meaning can be recognized.

text recognition
Written/printed text is automatically assessed for words or text modules by means of special software.

eye-tracking
This technical method records eye movements and uses this data as an interaction input. Vision fixation, fast movements and return movements are detected as parameters by real-time video analysis.

chroma-keying
This special technical method of video-post processing allows for the cropping of selected areas in the video image. In order to exactly define these image areas, it is necessary to assign the areas in question during recording to a monochrome colour such as blue (blue-screen) or green (green-screen). (Image background, objects etc.). By means of this technology, all coloured image information can be erased from the video image and can be replaced by artificially generated alternative images. This leads to the possibility of modelling image sections of camera recordings into the synchronous recording of a different site in real-time. This technology is often used to generate effects of telepresence, augmented reality and virtual reality.

bio-feedback
The data which is transmitted to the technological system during an interaction consists of measured values of the artist's, performer's or participant's vegetative body functions. Such measuring methods are EEG and ECG. Alternatively, the body temperature or heart rate is measured, or the sounds of internal organs are recorded.

force feedback
The participant interacts with the system using a haptic input device (typically a joystick) via physical impulses. The feedback is transmitted as mechanic, hydraulic or electric power via the input device.

sound analysis
The parameters of a sound which has been recorded by microphone are assessed in a digital analysis method and are then used as data.

custom
The technology used for the creation of the artwork is customary and is used as such in an unaltered form.

none
The interaction in the artwork does not rely on the use of digital technology or the transmission provided by a technological system (computer, machine, equipment).