MIROR-Musical Interaction Relying On Reflexion, PROJECT FINAL REPORT

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PROJECT FINAL REPORT

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Project acronym: MIROR

Project title: Musical Interaction Relying On Reflexion

Funding Scheme: Collaborative Project

Period covered: from 01/09/2010 to 31/08/2013

Name of the scientific representative of the project's co-ordinator[1], Title and Organisation:

Prof. Anna Rita Addessi,

Researcher

Alma Mater Studiorum – Università di Bologna

Tel: +39 0512091612

Fax: +39 051 2092001

E-mail: annarita.addessi@unibo.it

Project website[2] address: www.mirorproject.eu

[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement.
[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

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4.1 Final publishable summary report

The MIROR (Musical Interaction Relying On Reflexion) project is co-funded by the European Commission under the 7th Framework Programme, Theme ICT-2009.4.2, Technology-enhanced learning. MIROR is a three-years project and started on September 1st, 2010. All information regarding MIROR is available through the MIROR Portal at http://www.mirorproject.eu.

4.1.1 Concept

The MIROR Project deals with the development of an adaptive system for music learning and teaching based on the "reflexive interaction" paradigm. The system is developed in the context of early childhood music education. It acts as an advanced cognitive tutor, designed to promote specific cognitive abilities in the field of music improvisation, both in formal learning contexts (kindergartens, primary schools, music schools) and informal ones (at home, kinder centres, etc.). The reflexive interaction paradigm is based on the idea of letting users manipulate virtual copies of themselves, through specifically designed machine-learning software referred to as "Interactive Reflexive Musical Systems" (IRMS). By definition IRMS are able to learn and configure themselves according to their understanding of the learner's behaviour. In MIROR the IRMS paradigm is extended with the analysis and synthesis of multisensory expressive gesture to increase its impact on the musical pedagogy of young children, by developing new multimodal interfaces. The project is based on a spiral design approach involving coupled interactions between technical and psycho-pedagogical partners. MIROR integrates both psychological case-study experiments, aiming to investigate cognitive hypotheses concerning the mirroring behaviour and the learning efficacy of the platform, and validation studies aiming at developing the software in concrete educational settings. The project contributes to promoting the reflexive interaction paradigm not only in the field of music learning, but more generally as a new paradigm for establishing a synergy between learning and cognition in the context of child/machine interaction.

4.1.2 Objectives

The MIROR project aims primarily at developing the potential of IRMS for the benefit of *music education*. More precisely, MIROR's primary goal is to develop an adaptive and intuitive system for music education, based on the reflexive interaction paradigm. This includes:

The design and implementation of a platform, the **MIROR platform**, including the core technological modules needed to implement the reflexive interaction paradigm (e.g. modules for analysing the musical behaviour of learners, modules for analysing expressive full-body movement and gestures, modules for session and interaction management, and so on).

The design and implementation of three **MIROR prototypes** (Fig. 1), grounded on the MIROR platform, addressing different aspects of music education and exploiting different qualities of the reflexive interaction paradigm:

The **MIROR-Improvisation prototype** (MIROR IMPRO hereinafter), addressing music improvisation.

The **MIROR-Composition prototype** (MIROR COMPO hereinafter), addressing music composition.

The **MIROR-Body Gesture prototype** (MIROR-Body Gesture hereinafter), exploring how full-body movement and gesture can enhance music learning.

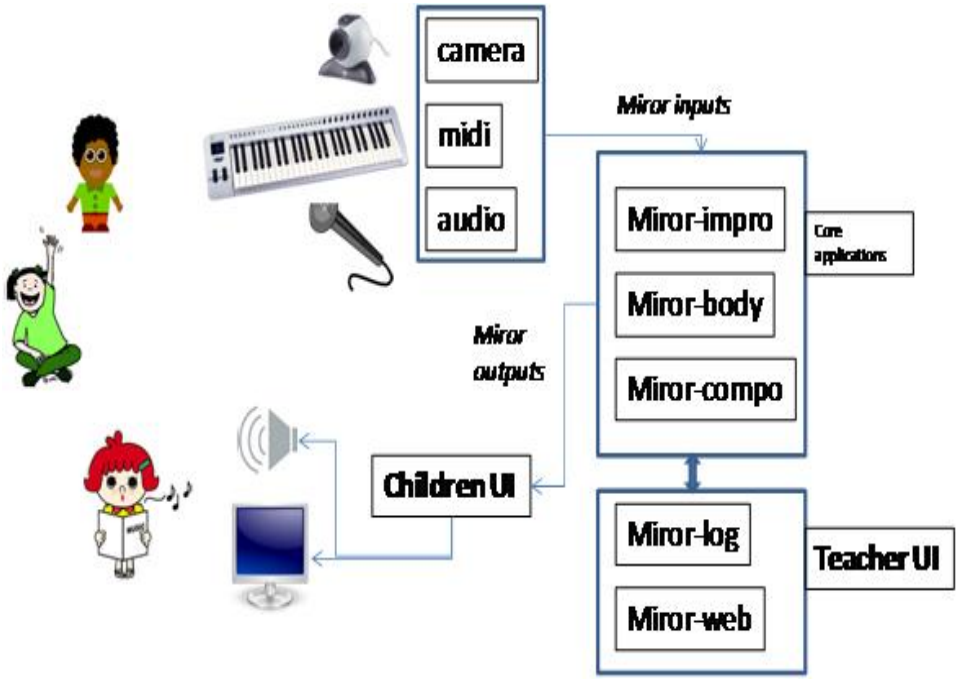

Fig. 1 – Overall architecture of the MIROR Platform

The **validation** of concrete pedagogical scenarios in which IRMS organise and stimulate the learning/teaching processes in the domains of music improvisation, composition, and body performance; the validation of the MIROR platform and prototypes in such scenarios.

The development of a detailed analysis aimed at assessing the impact of the reflexive interaction paradigm on both music learning and cognitive processes. The **theoretical framework of the reflexive interaction** will be investigated and implemented on the basis of the experimental results and of specific studies addressing the pedagogy of reflexive interaction.

The promotion of an **active approach to musical culture**, based on ”music making” rather than on ”music consuming”. The promotion of the social-cultural perspective with regard to music education and creativity, integrating embodiment into technology-enhanced learning.

4.1.3 Consortium

Alma Mater Studiorum - Università di Bologna (UNIBO), Italy – Coordinator.

Sony Europe Limited acting through Sony France Computer Science Laboratory (SONY), France.

Università degli Studi di Genova (UNIGE), Italy.

Goeteborgs Universitet (UGOT), Sweden.

National and Kapodistrian University of Athens (NKUA), Greece.

The University of Exeter (UNEXE), United Kingdom.

Compedia Software & Hardware Development Ltd. (COMPEDIA), Israel.

4.1.4 Work performed and major results achieved so far

4.1.4.1 The First Year of the Project

The first year of the project was mainly devoted to the integration of background knowledge from partners, to the definition of the requirements for the MIROR platform and prototypes and for their interfaces, to the development of the initial version of the MIROR platform and prototypes, to the performance of a first series of experiments in concrete pedagogical scenarios. Early results include the following:

- UNIBO, UGOT, NKUA, and UNEXE (psycho-pedagogical partners) investigated several **theoretical aspects** dealing with IRMS, both in the context of music education and cognitive sciences of music, and in the more general field of learning in an interactive scenario. A review of relevant literature was carried out and the theoretical background concerning the cognitive and creative processes, which are implicated in IRMS, was discussed. In particular, the following topics were considered: the mirroring interaction; the theory of Flow in reflexive scenarios; the cognitive processes of music improvisation in children; the learning/teaching processes in a reflexive and interactive scenario; music therapy and community music settings.

- The **initial version of the MIROR platform** was developed to provide the Consortium with running prototypes as soon as possible. SONY and UNIGE (technological partners) carried out this work in close loop with the psycho-pedagogical partners - who provided feedback on the outputs needed for the experiments, manipulation of musical parameters involved (rhythm, dynamics, texture, etc.), and development of specific settings -, and with COMPEDIA who also provided feedback on exploitation issues. The following major results were achieved:

  - New algorithmic solutions such as the novel musical sequence generation algorithm with constraint satisfaction scheme (SONY) and the techniques for extraction and processing of movement and gesture features (UNIGE) were developed, successively tested, and integrated into the prototypes.
  - Several core technological modules such as session management, session visualisation, music score display, and export functionalities were developed and integrated.
  - Future integration abilities were addressed in particular by developing various independent software libraries, which will be used in MIROR prototypes through evolving, but clearly defined APIs (Application Programming Interface).
  - Hardware needs and compatibilities were studied and hardware selection was made.
  - Tools for connecting the MIROR prototypes were investigated, and an initial proof-of-concept of such a connection to generate musical outputs by gesture analysed in real time, was developed and tested.

- The **initial versions of the three MIROR prototypes** were developed (SONY and UNIGE) and provided to the psycho-pedagogical partners for early feedback. In particular:

  - SONY developed the initial MIROR IMPRO prototype. Its focus is the basic musical level (notes, clusters, and sequences thereof). Since the early stages of the project eleven

different versions were delivered to the consortium, and many new features, bug fixes, and comments, in particular concerning the user interface, were progressively integrated, including a session management tool to record, save, retrieve, and visualise the musical information exchanged during each session in an easy way.

- SONY developed the initial MIROR COMPO prototype. MIROR COMPO grounds on MIROR IMPRO and aims at teaching children how to reflect on a larger scale than the basic musical level.
- UNIGE developed the initial version of the MIROR-Body Gesture prototype. This prototype mainly enables children to perform exploration of sound and of musical concepts by means of their body movements and gestures. The framework integrates customisable exercises, with different levels of complexity, spanning over different dimensions of sound and over different music concepts.
- SONY and UNIGE developed the initial versions of the interfaces for the MIROR prototypes, with particular reference to the MIROR IMPRO prototype (Fig. 2). Following the feedback by the Consortium, COMPEDIA developed a mock-up for an improved version of the teacher interface for the MIROR IMPRO prototype (Fig. 3).

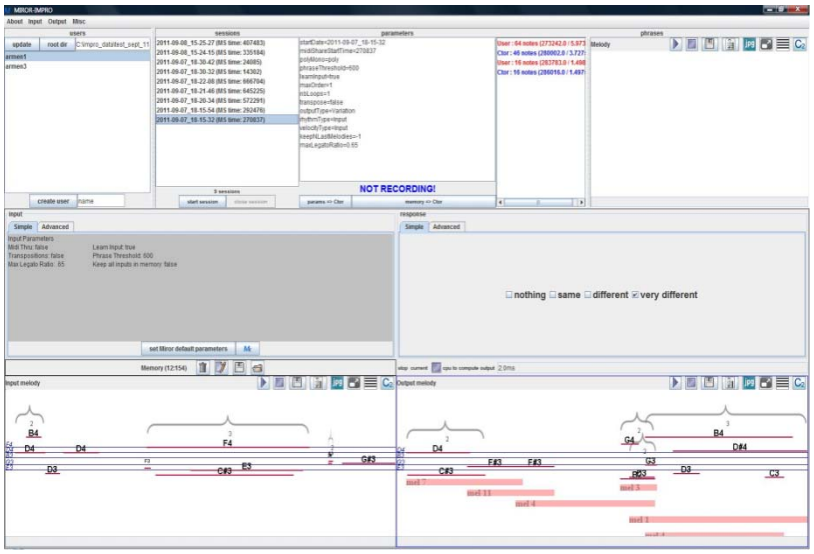

Fig. 2 - Initial version of the MIROR IMPRO interface

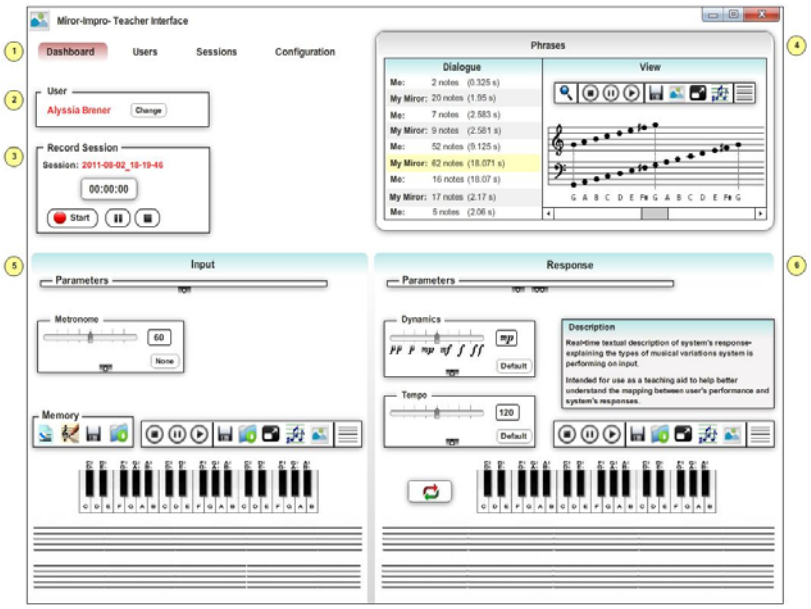

Fig. 3– MIROR IMPRO. Sample of the new suggested UI design

- **Experiments with children:** UNIBO, UNEXE, UGOT, and NKUA prepared and carried out experiments with children and the MIROR IMRPO prototype. From September 2010 to April 2011 the psycho-pedagogical partners planned, in strict collaboration with the other Partners SONY, UNIGE, and COMPEDIA, two protocols and several exploratory studies to be carried out with children in kindergarten and primary schools. In April-August 2011 the experiments and further minor exploratory studies were performed in Athens (NKUA), Bologna (UNIBO), Gothenburg (UGOT), and Birmingham (UNEXE). Almost 100 children were involved in the experiments. Initial considerations can be made as follows:

- The collected archives represent a rich data collection.
- The results obtained so far show that the MIROR IMPRO prototype works and can have a positive effect on the level of Flow of the child while improvising, providing a rich interaction context.
- The results indicate several suggestions in order to further improve the system, the interface, the equipment and the setting, and suggest new experimental hypotheses to be tested.
- The results suggest new interesting experimental ideas to be implemented with the next versions of MIROR IMPRO and with the recent MIROR COMPO prototype.
- The results raise interesting theoretical aspects concerning perceptual and cognitive issues on the reflexive scenario with young children, music perception and music analysis, music therapy, and different socio-pedagogical contexts.
- An overview of the data and results that partners collected underlines how carrying out different protocols in a range of contexts was positive and enriching for the project.
- During months 9-12, starting from the results of the experiments carried out with MIROR IMPRO and analysing the literature about composition with children, the Consortium started

the preparation of the experiments with MIROR COMPO and MIROR-Body Gesture that were delivered at the end of August 2011. Experiments will be carried out in year 2.

- The Consortium organised **two workshops** (Paris, November 2010; Gothenburg, March 2011) to work on experimental designs, requirements of the platform and prototypes, hardware and technical equipment. The goal was to transfer the results of user testing to the prototype implementation and vice versa.

- The **MIROR website** has been delivered on Month 3 (UNIBO) (www.mirorproject.eu).

- The **logo of the project** was created by UNIBO on the basis of a writing made by a 5 year-old child who was asked to write the word "MIROR" on a yellow and a red line (as from the medieval musical score). In a spontaneous way, the child wrote the last letter "R" in reverse, giving the idea of the mirroring effect and of the reflexive paradigm.

MUSICAL INTERACTION RELYING ON REFLEXION

- **Secured video sharing service** was enabled by COMPEDIA and is used for sharing videos and comments among researchers. It also includes a sub-set of approved videos for demonstration and exploitation purposes.

- The project was **disseminated** to the scientific community through presentations at conferences. Initial research results were published or submitted for publication. A special issue of the journal "Musicae Scientiae" on MIROR topics is planned for publication at the end of the project.

4.1.4.2 The Second Year of the Project

The second year of the project was mainly devoted to a deeper definition of the theoretical framework of the reflexive interaction paradigm in the field of childhood technology-enhanced learning, to the performance of experiments with particular attention to the children's and teacher's interaction with the platform in concrete pedagogical scenarios, to the methodological implementation of quantitative and qualitative research supported by a "mixed method" approach, to the refinement of the requirements for the MIROR platform and prototypes and for their interfaces, to the implementation of the spiral process of specification leading to the development of the second version of the MIROR platform and prototypes. The second year was mostly devoted to the implementation of MIROR COMPO and MIROR-Body Gesture, and to the integration of the three MIROR components. Exploratory studies on composition and embodiment were realised with MIROR COMPO and MIROR-Body Gesture. Finally, the Consortium designed and implemented studies addressing usability and user experience aspects with the MIROR platform and related components (Impro, Compo, and Body Gesture), to be carried out in the 3rd year of the Project. The

initial step for market analysis was implemented and a survey has been launched aiming at identifying and evaluating the demand for the MIROR platform among different segments and users.

Results include the following:

- The theoretical framework of reflexive interaction paradigm has been defined more deeply. In particular, the theoretical framework focuses on reflexive interaction, also including children's developmental models in improvisation, composition, and body gesture. The theoretical framework of the reflexive interaction paradigm has been developed from a systematic perspective. It starts from the theoretical and technical background of the IRMS and follows with an attempt to explain the human behaviours involved in the reflexive interaction, starting from the behaviours observed in children interacting with the "Continuator", the first prototype of IRMS. These highlighted elements have been proposed to support the fundamental hypothesis of the MIROR Project, that reflexive interaction enhances teaching/learning processes and musical creativity. This places the theoretical basis for a pedagogy of reflexive interaction and for exploiting IRMS in the field of technology-enhanced learning and therapeutic/rehabilitative actions. Starting from IRMS and the experience with children, some fundamental requirements have been identified in order to implement new interactive reflexive musical systems. The background on children's improvisation, composition, and dance education is considered, and related to the reflexive interaction.
- Performance of experiments with particular attention to children's and teacher's interaction with the platform in concrete pedagogical scenarios and methodological implementation of quantitative and qualitative research supported by a "mixed method" approach. Several exploratory and experimental studies have been carried out by UNIBO, NKUA, UGOT and UNEXE with MIROR IMPRO, MIROR COMPO, and MIROR Body Gesture prototypes. Results with MIROR IMPRO support the hypothesis that reflexive interaction and MIROR IMPRO enhance children's Flow emotional state and several kinds of listening conducts and behaviours, enhancing music learning and creativity**.** The results indicate that children's ability to improvise in dialogue with a computer depends on their previous experience and the cultural tools they have already acquired by participating in other musical settings. Computational music analysis revealed specific repeated patterns that children use when they play the keyboard. In the first sessions these are indicative of various gestures that children use when they play (such as repetition of one note, movements up and down the keyboard, oscillations between two notes, etc.). After some sessions with the system, however, the playing becomes more focused and exploratory, and children use their fingers more, rather than big arm movements. Three levels of interaction with MIROR IMPRO were observed and differences between girl/boy and 4-8 year olds were observed as well. The experiments with MIROR COMPO raised interesting reflections about children's music composition and suggest that the system acts as a "musical scaffolding" (the "actions" system) that allows children to develop the ability to create new ways to combine each other's actions, i.e. to "compose" music. The results of the studies in therapeutic settings showed that there is a clear enjoyment of the sessions with the system, proving that it is an appropriate and fun tool to use for therapeutic purposes. The experiments with MIROR-Body Gesture drafted the methodological process of designing MIROR-Body Gesture, focusing on the new issue of reflexive interaction in the body gesture system, designed the pedagogical framework of MIROR-Body Gesture, collected several pedagogical scenarios, and deeply analysed the Laban' Effort Weight boundaries (heavy/light) in children movement and music performance. Researchers had the opportunity to share ideas and pedagogical issues with the teachers of the

primary and kindergarten schools regarding the ecological setting for the experiments and the teachers training activities.

- Refinement of the requirements and implementation of the spiral process of specification for the MIROR platform and related components, and for their interfaces. During project year 2, two workshops have been carried out. Different psychological tests executed by the psycho-pedagogical-partners have contributed to the development of new and improved versions of the MIROR platform by SONY and UNIGE. By applying the spiral process between user testing and MIROR prototypes design and implementation, the results of user testing were transferred to prototype implementation. Psycho-pedagogical partners provided feedback to technological partners, including lists of recommendations.

- MIROR Libraries: The second year was mostly devoted to the implementation of MIROR COMPO and MIROR-Body Gesture, and to the integration of the three MIROR components. This included the development of the final versions of the core technological modules on which the MIROR prototypes are grounded on, and of the support modules for connecting the MIROR Prototypes. SONY and UNIGE conducted this work in close loop with the psycho-pedagogical partners -who provided feedback on the types of system output needed for the experiments, manipulation of musical parameters involved (rhythm, dynamics, texture, etc.), and development of specific settings-, and with COMPEDIA who also provided feedback on exploitation issues. The following major objectives were achieved:

- Algorithmic solutions such as the novel musical sequence generation algorithm with constraint satisfaction scheme (SONY) were improved and adapted to the context of MIROR COMPO prototype
- New and extended techniques for the analysis of expressive qualities of movement and gesture (UNIGE) were developed: in particular, the framework of Laban's Theory of Effort was addressed (Space, Time, and Weight) and machine-learning techniques were developed for the analysis of Laban's quality on a selected gesture vocabulary. Recognition is grounded on techniques for extracting 3D features from movement trajectories provided by the Kinect sensor. Features developed in MIROR and added to the EyesWeb XMI libraries include, for example, 3D curvature and sphericity.
- Various core technological modules such as session management, session visualisation, music score display, tagging and export functionalities were extended and adapted to MIROR COMPO prototype
- Integration of MIROR IMPRO and MIROR-Body Gesture prototypes has been further investigated.

- MIROR prototypes (IMPRO, COMPO, and Body Gesture). Major achievements in the reporting period are summarised as follows:

- Development of the final MIROR IMPRO prototype (SONY). Intensive specification and development was conducted during year 2 (10 versions along Year 2). The prototype was evaluated with experiments;
- Development of the final MIROR COMPO prototype (SONY). Intensive specification and development was conducted during year 2 (10 versions along Year 2). The prototype was evaluated with experiments;

- Development of the second version of the MIROR-Body Gesture prototype (UNIGE). Intensive specification and development was carried out during year 2. The prototype is being evaluated with experiments.

- The Consortium planned **studies addressing usability and user-experience** to be carried out in the 3rd year of the Project with the MIROR platform and related components (IMPRO, COMPO, and Body Gesture). The studies address the child's particular relationship with technology on the one hand, and the child's experience on the other hand. The results of these studies should lead to a clear and explicit list of recommendations that are useful for further technological development. Further validations of the interfaces are being discussed (video observation, experience with small group of teachers).

- The initial step of market analysis was implemented and a survey has been launched by Compedia in collaboration with the other Partners, aiming at identifying and evaluating the demand for the MIROR platform among different segments and users.

- Dissemination of results: This includes (i) update of the project website, (ii) giving the project visibility with respect to the scientific community, the stakeholders, and the general public, (iii) publishing results from the project, (iv) creation of the MIROR newsletter.

4.1.4.3 The 3rd Year of the Project

The results of the 3rd Year include the following:

- Spiral process of specification

Two final workshops took place in Exeter (September 2012) and Bologna (March 2013). In Bologna SONY and UNIGE held technical presentations of the final software of MIROR IMPRO, COMPO and Body Gesture, including practical tests by all the participants. This was connected to a summary of the pedagogical experiments carried out within WP6 by UNIBO, UNEXE, UGOT and NKUA. The collaborative activities concerning the results of the final pedagogical experiments further contributed to the discussions in the spiral process. These activities also involved members of the Advisory and Liaison Board, and the Consortium decided to give the ALB members access to prototypes.

- Core technological modules

SONY and UNIGE continued to implement new features to improve the software. SONY achieved the implementation by introducing several new core features, among which:

- Added a cycle detection/avoidance feature in response generation (solves the sticky note problem),
- Added a melody randomizer feature for U. Athens experiments.
- Accuracy of phrase segmentation algorithm (phraseThreshold) was improved drastically (from about 100ms to 1ms),
- Export of melodies to MP3 format.

UNIGE extended the EyesWeb XMI platform by integrating new modules, both general purpose modules and modules specifically devoted to movement and gesture analysis:

- EyesWeb XMI was endowed with a new datatype for floating-point operations, explicitly handling significant digits in computations involving physical measures. This allows for meaningful and more robust computations, especially on MoCap data from Kinect.
- EyesWeb XMI was endowed with new modules (blocks) for generating and processing floating-point data taking into account significant digits and using the datatype mentioned above. This includes basic operations (e.g., arithmetic operations), derivatives, and statistical descriptors. Such new modules were used for improving feature extraction for movement analysis.
- The EyesWeb blocks for Kohonen self-organising maps were extended and improved in order to handle supervised classification problems, where labels of feature vectors to be classified are provided during the training process.
- Analysis of child's movement in terms of Laban's Effort dimensions was improved and refined. Use of Kohonen self-organising maps allowed for adaptation of movement analysis to the motoric behaviour of each single user. A more fine-tuned analysis on four different levels for each Effort dimension (two extreme and two intermediate levels) was achieved.

- MIROR prototypes

SONY achieved the final MIROR IMPRO prototype. MIROR IMPRO has been designed and implemented using the various new API developed in WP3 during year 2. During year 3, four different versions were delivered to the consortium, and many new features, bug fixes, and comments, in particular concerning the user interface, were progressively integrated. NKUA, UNIBO, and UNEXE contributed to the specification and design of the MIROR-Improvisation prototype on the basis of their work and research experience with children, and provided feedback to SONY.

SONY achieved the final MIROR COMPO prototype. MIROR COMPO has been designed and implemented using the various API integrated and developed in WP3. The final prototype includes a session management tool to record, retrieve, export to a webservice and visualise the musical content and user choices. NKUA, UNIBO, and UNEXE contributed to the specification and design of the MIROR IMPRO prototype on the basis of their work and research experience with children, and provided feedback to SONY.

UNIGE achieved the final version of the MIROR-Body Gesture prototype. In particular, following year 2 feedback from the initial evaluation, from psycho-pedagogical partners and from reviewers, the BeSound application was extensively reworked. Personalised and adaptive models were introduced grounding on Kohonen self-organising maps and reflecting both the motoric behaviour of the child and her movement and sound space exploration. Cross-modal reflexive music dialogue was improved and extended. An algorithm for determining the system's responses on the basis of the behaviour of the child and of the pedagogical goals of the teacher was implemented. New features were introduced (for example, higher variety of sounds, the possibility of storing session

data, improved user interfaces, management of users and sessions). Five versions of MIROR-Body Gesture, including the new developments of BeSound, were released along year 3 (February, March, May, June, and August 2013). UNIBO contributed to recommendations for improving the design of MIROR Body-Gesture on the basis of their experiments with children, and provided feedback to UNIGE.

- Theoretical results related to the IRMS – creative musical processes and cognition/learning

In order to study the IRMS, the Partners present different topics concerning the theoretical study on IRMS paradigm in learning processes.

UNIBO has analysed several aspects dealing with IRMS, both in the context of music education and cognitive sciences of music, and in the more general field of learning in an interactive scenario. In particular, the following topics were studied on the basis of the experimental results: the mirroring interaction, the theory of Flow in reflexive scenarios, the cognitive constraints in children interacting with MIROR IMPRO, the processes of music improvisation in children, learning/teaching processes in the reflexive and interactive scenario, reflexive interaction and embodied music cognition, music therapy and reflexive interaction. UNIBO carried out experiments in order to study if the reflexive interaction could enhance musical dialogue and creativity in children at the beginning stages of learning music improvisation, in particular when using the MIROR Platform during the "deliberate practices" at home. UNIBO also carried out several focus groups with university students who are undergoing teacher training, in order to extrapolate educational conceptions related to the MIROR Platform.

UNIBO has addressed specific topics as the link between the interactive reflexive paradigm, embodied music cognition and Laban movement analysis, through both theoretical insights and exploratory studies with MIROR-Body Gesture, and experimental studies, which combined MIROR IMPRO and body movements. In order to improve the child/machine reflexive interaction by means of body and creative movement and to integrate the body expression in reflexive technology, UNIBO carried out the following activities: analysis of the child's experience of the reflexive interaction, creation of an overview of reflexive interaction requirements. This list of requirements has been used as a basis for the exploratory studies with the MIROR-Body Gesture and to formulate feedback and recommendations for UNIGE in order to implement the Body Gesture component of the MIROR Platform. In particular, to measure the improvement in the quality of children's movements, we implemented an original grid, by means of the software Observer (Noldus copyright), based on the Laban Movement Analysis, created by the choreographer Rudolf Laban (1879-1958) to analyse the movements of dancers. The preliminary experimental results support the hypothesis that reflexive interaction could enhance the quality of children's movements.

UGOT addressed two basic issues concerning the work on the MIROR technologies, and on the background of contemporary research on children's composition. The two issues are the following: (i) Composition in the digital age, and (ii) the collaborative nature of composition. What UGOT has studied during the project is how children collaboratively compose (and also improvise) in natural settings with an analytical interest in *interaction* and *reflection.* One finding that informs the reflexive paradigm with new insight is that children's interaction with each other (and the teacher if present) takes priority over their interaction with the system, when used collaboratively. These

results would confirm the pilot study and hypotheses,[3] and the more recent studies,[4] that the system positively affects the social interaction among children and between children and teachers, developing collaborative playing and joint attention.

UGOT also raised several issues as commentaries to the application of the MIROR-Body Gesture and the combination of audio and gesture communication, taking the learner's perspective into account and different concepts of variation, and what learning to use this technology may result in. A third issue that UGOT raised concerns the concept of variation and what patterns of variation does the technology provide in interaction with the learner and hence, what does it make possible to learn. Finally, UGOT highlighted how the reflexive interactive paradigm can be related to socio-cultural theory.[5]

UNEXE has focused its attention on the application of MIROR technologies and on exploring how the children use the equipment in 'real world' educational contexts. Our questions have focused on the nature of engagement between children and MIROR IMPRO and COMPO; what children are learning from the processes of using MIROR and how this might be enhanced, either through the types of adult interactions to structure or guide their activity or through further strategies such as visualisation. UNEXE has been interested in the nature of musical thinking that is generated in play with MIROR technologies. In work with both MIROR COMPO and MIROR IMPRO we theorised that the activity of listening back immediately to musical ideas which are similar to but not the same as the child's own input requires the child to relate what has just been played bodily and heard, with what is now heard as sound only. Importantly we found that the children need to also acquire a language for talking about musical ideas with peers and adult if their learning is to be extended and consolidated.

UNEXE developed a further study with young pianists, for whom the keyboard was no longer a novelty and who already had keyboard skills. This study revealed that the children developed a number of strategies over a course of sessions to 'manage' the replies in ways they found meaningful on musical terms. The MIROR responses can be musically unsatisfying, but this then stimulated the children to find inventive ways to manage the replies. However, the balance between frustration that stimulates creativity and frustration that dampens motivation is a crucial one and the teacher needed to intervene to maintain a balance that was positive in learning terms. We looked for approaches in which the adult could develop three-way interactions between child, technology and adult that helped to guide the children's play with the equipment and stimulate the musical imagination.

[3] A.R. Addessi & F. Pachet, Experiments with a musical machine. Musical style replication in 3/5 year-old children. *British Journal of Music Education*, 22(1), pp. 21-46, 2005; L. Ferrari, A.R. Addessi & F. Pachet, New technologies for new music education: the Continuator in a classroom setting, in Baroni et Al. (Eds), *Proceedings of the 9th International Conference of Music Perception and Cognition*, Bononia University Press, Bologna, 2006.

[4] A.R. Addessi, From Echo to the mirror neurons: Founding a systematic perspective of the reflexive interaction paradigm". In E. Cambouropoulos, C. Tsougras, P. Mavromatis, & K. Pastiadis (Eds.), *Proceedings of the 12th International Conference on Music Perception and Cognition (ICMPC) and the 8th Triennial Conference of the European Society for the Cognitive Sciences of Music (ESCOM*), 23-28 July 2012, Thessaloniki, Greece, 9-19.

[5] B. Rogoff, *Apprenticeship in thinking: Cognitive development in social context*. New York: Oxford University Press, 1990; L.S. Vygotsky, *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press, 1978.

Reflexive Interaction in relation to therapy setting
UNIBO carried out an exploratory study with a child with Down's syndrome and an exploratory study with children in therapeutic setting concerning music therapy as a prevention tool. From the theoretical point of view, the IRMS offer a useful paradigm to study the communicative process in music therapy, since the IRMS, through the mechanism of repetition/variation, do not exactly mimic the user's proposal, but her/his own musical style, and her/his own musical identity. Data analysis referred to: 1) an event-based analysis of musical improvisation through the *Improvisation Assessment Profile* (*IAP*) by Kenneth Bruscia, using the guidelines offered by Tony Wigram;[6] 2) an analysis of dyadic communication process through the Relational Coding System by Alan Fogel.[7] The results shows that introducing the MIROR IMPRO could encourage the emerging of combined innovative actions in communicative process and enhance musical creativity.

NKUA proposed to use the MIROR IMPRO system in this kind of population with three therapeutic goals: 1) creating a sonic mirror, where the patient could regress to early infancy and find a chance to be heard, recognised and thus reconstruct his/her Self through musical reflexion; 2) proposing an interactive musical instrument as a transitional object, that would function as an intermediate between the patient and the outside world, including the therapist. The final goal would be to facilitate the creation of a relation with the therapist in pathologies where relation with human beings is very difficult; 3) enhancing a contact with the external reality, by inviting the patient to listen to his own musical reflexion and verbalise on it.

Although not strictly in the field of music therapy, UNEXE carried out a small study in a special unit for children with behavioural difficulties who cannot attend mainstream school. We hypothesised that MIROR technologies might have potential to engage children whose behaviour reveals autistic spectrum characteristics. We found some evidence to suggest that children with ASD (autism spectrum disorder) behaviours may engage more with MIROR technologies than with comparative classroom-based activities and that there would be future in developing this line of application.

- Pedagogical Experiments
UNIBO, NKUA, UGOT and UNEXE carried out several pedagogical experiments, in collaboration with SONY and UNIGE and several results were collected, as follows:

- Pedagogical aspects of IRMS have been explored, tested and evaluated in different contexts in four countries, Sweden, UK, Greece and Italy; mainly in school situations (individual, group and whole class) and also therapeutic and community situations.

[6] K. Bruscia, Improvisational models of music therapy. Springfield, IL: Charles C Thomas Publishers, 1987; T. Wigram, *Improvisation: methods and techniques for music therapy clinicians, educators and students*. London: Jessica Kingsley Publishers, 2004; T. Wigram, Event-based analysis of improvisations using the Improvisation Assessment Profiles (IAPs). In R. R. Pratt & D. E. Grocke (Eds.), *MusicMedicine 3: Musicmedicine and music therapy: Expanding horizons* (pp. 211-226). Parkville, Victoria: Faculty of Music, University of Melbourne, 2007.

[7] A. Fogel & M. Lyra, Dynamics of development in relationship. In F. Masterpasqua, & P. Perna (Eds), *The Psychological Meaning of Chaos: Self-Organization in Human Development and Psychotherapy*. Washington, DC: American Psychological Association, 1997; A. Fogel, Oltre gli individui: un approccio storico – relazionale alla teoria e alla ricerca sulla comunicazione. In M. L. Genta (Ed.), *Il rapporto madre-bambino*. Roma: Carocci, 2000.

- Action research procedures were developed for work in educational settings and observation protocols were devised to assess the application of the MIROR platform in educational and therapeutic settings.
- A user guide and teachers' guide have been prepared. Work has explored the integration of MIROR enhanced activities within the curriculum frameworks of the UK, Italy, Greece and Sweden.

As a result of this activity the psycho-pedagogical partners have:

1. contributed to some final-stage developments of the technology and its interface;
2. increased understanding of the ability of the MIROR system to enhance children's learning processes in creative music-making (both improvisation and composition) and increased understanding of its therapeutic potential;
3. increased understanding of how reflexive music technologies might enable certain music-learning processes, particularly those associated with the retention of style and with creativity, and considered the notion of reflection from within a socio-cultural theoretical framework;
4. increased knowledge of how the MIROR platform might be integrated into educational contexts within systems of schooling as they differ across the European countries involved in the project;
5. contributed information for the development of a marketable music technology for use in education, therapeutic and community contexts.

- Implementation and validation of MIROR systems interfaces

SONY continued to gradually improve the interface of IMPRO and COMPO. UNIGE continued to improve the interfaces for BeSound (the interfaces for the Potter were already delivered in year 2) and delivered the final version of them. Feedback was received from UNIBO, UNEXE, UGOT and NKUA. The UNIGE work focused on:

- Improvements to the teacher interface of BeSound, including new windows for managing the newly introduced working modes (transitions and music dialog), controls for simplifying the flow of the activity (e.g., skipping the introduction movies if already played), new windows for managing and controlling the adaptation of the self-organising maps modelling the behaviour of the user, new windows for managing users and sessions.
- Improvements to the children interface of BeSound, including a zoom mechanism for adapting the interface to the size of the body of the child and refinement of the selection mechanism.
- A comprehensive user manual was delivered to explain the use of the interfaces.

UNIBO and UNEXE carried out several usability tests and sent feedbacks and recommendations to SONY and UNIGE. A usability questionnaire was implemented by UNIBO in collaboration with Dr Luc Nijs and Prof. Leon Van Noorden (IPEM, University of Ghent) and was submitted to the participants of the MIROR Summer School (The Hague, July 2013).

- Dissemination of results: With reference to the dissemination and exploitation objectives, the achievements during the 3rd reporting period were the following:

- Continuous updating of the project website (www.mirorproject.eu) - News, Partner Area, Publications-, and preparation of dissemination material.
- Continuous updating of the Home page of the windows "Work in progress" and “Subscription list”, and creation and updating of the page “Publications on IRMS”.
- Continuous updating of the Deliverables accessible to the EU Commission and Reviewers.
- Periodical analyses of traffic on the web site.
- Periodical MIROR newsletter to inform a wider public about the implementation, the activities, the events and the results of the MIROR project.
- On the occasion of relevant international meetings, the MIROR project and its underlying ideas have been presented and the papers have been published in the Proceedings.
- Several contacts have been established with networks and associations in the field of music science and technology-enhanced learning.
- An online survey has been carried out. The main goal of this survey was to gather attitudes of the music and dance teachers and opinion leaders in the industry, to identify needs, and define the channels for promotion and dissemination.
- The industrial exploitation plan has been carried out based on the secondary sources market overview, and the analysis of the inputs and feedbacks provided by the opinion leaders to whom the system was presented.
- MIROR project’s Wiki portal. The music and video server, an associated taggable interface was implemented.
- Exploitation Agreement and the Exploitation Academic Plan were defined.
- The MIROR Summer School was held at the MERYC Conference, The Hague, Netherlands, in July 2013, attended by educators and researchers from many European countries. The participants were able to try out the equipment and to discuss its application within their own contexts.

4.1.5. Expected final results and their potential impact and use

The expected final results of the project are fully functional MIROR prototypes, assessed with experiments with children and grounded on solid theoretical bases. Impact is expected on education and learning, starting from music education, but possibly extending to other fields. Moreover, MIROR aims to:

- Develop a detailed analysis to assess the impact of the reflexive interaction paradigm for both music learning and general cognitive/learning processes.
- Promote an active approach to musical culture, based on a "music-making" concept, rather than "music-consuming"; promote the use of the MIROR platform in children and adults, enabling a wider access to music by experts as well as non experts; enhance the diffusion of music culture in EU society through experiments with the MIROR platform in several European countries; produce a User Guide and a Teachers' Guide.

In particular, the Consortium planned the Exploitation Academic plan, which includes the following *Sectors of research activities:*

- UNIBO research areas include the following: Child/machine interaction, technology-enhanced learning, e-learning, reflexive interaction and creativity, children's music improvisation and composition, teacher education, music therapy, embodied music cognition, dance education, artistic performance, evolution of music language, vocal child/adult interaction, singing development in children. In particular, the UNIBO team is planning to fully realise the MIROR Pedagogical Framework by implementing the missing parts of the MIROR platform, i.e., the learning/teaching modules for using the three software applications (MIROR IMPRO, MIROR COMPO and MIROR Body Gesture): the users'/teachers'/researchers' interfaces; the learning-objects for teachers, music therapists, children of different ages, music teachers, dance educators, tutors facilitators, teachers' training tools, etc.; the two data bases (Children_Log - ,for teachers: to upload interesting children compositions, improvisations and choreographies. Work in progress, for researchers: to upload interesting practices, experiments and videos, documenting the work in progress research).

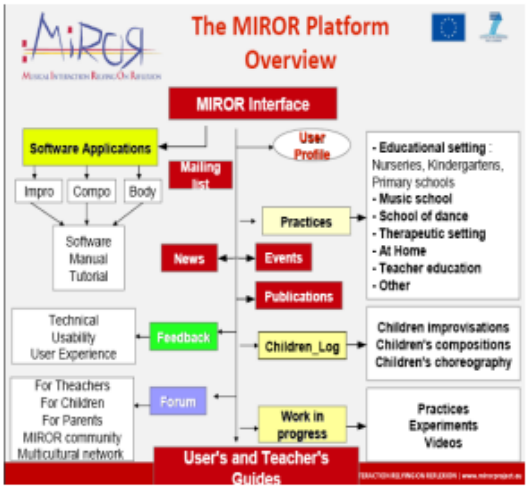

Figure 3: *An overview of the MIROR Platform architecture showing the most important parts as described in the section above (as from Addessi A.R (2013).* Child/machine interaction in reflexive environment. The MIROR Platform. In *Proc. of SMC2013, Stockholm).*

In particular, UNIBO will exploit the following knowledge:

- The concept of MIROR platform as a learning/teaching/research virtual environment exploiting the reflexive interaction paradigm not only in music improvisation education but also in the field of body gesture analysis, and potentially in other learning/teaching.
- The design and implementation of pedagogical processes and guides for teachers and children to be used with MIROR applications.
- The theoretical framework of reflexive interaction paradigm for educational purposes.
- Experimental protocols: Protocol no 1 and no2 of DoW, protocol Body-IMPRO. Protocol in music-therapy setting.
- Flow grid by software Observer.
- Laban grid by software Observer.

- Listening grid by software Observer.
- Grid of Sound/Movement connection, for MIROR-Body Gesture.
- Grid with Modes of Dialogue, for MIROR-Body Gesture.
- "Duets" grid, for the observation of musical dialogue between 2 children, by software Observer.

SONY Research areas include the following:

- [ACM Computing Classification System, 1998 H.5.2.] Information interfaces and representation: User interfaces – Interaction styles, user-centred design, auditory feedback.
- [ACM Computing Classification System, 1998] K.3.1. (Computers and education): Computer uses in education – computer assisted instruction.
- [Other sectors] Child/machine interaction; technology enhanced learning, e-learning, reflexive pedagogy, teacher education, music therapy, embodied music cognition, performing arts, sport, score visualisation, musical software handling MIDI signal.

In particular SONY will exploit the following knowledge:

- Constrained Markov Processes: Algorithm for generating Markov chains satisfying unary constraints.
- MIROR IMPRO application: Application for real-time generation of improvisation in the style of the user.
- MIROR COMPO application: Application for off-line generation of compositions in the style of the user.
- MidiShare 32-64: real-time musical MIDI operating system, providing high level services to the field of computer music and MIDI applications.
- JGuido and GlnToGmn Libraries: Full-fledged musical score notation display, which handles realtime, arbitrary MIDI inputs.
- "Style game" experiment: Analysis of preservation of individual musical style (principle of comparison between human and machine generated melodies).

UNIGE Research areas include the following (ACM Computing Classification System, 1998):

H.5.2. Information interfaces and representation: User interfaces – Interaction styles, user-centred design, auditory feedback

K.3.1. (Computers and education): Computer uses in education – computer assisted instruction.

In particular, UNIGE will exploit the following knowledge:

- Annotated archive of children performing selected gestures according to different Laban's effort qualities.
- EyesWeb applications for synchronised recordings of video and mocap.
- Extensions to EyesWeb XMI making a EyesWeb platform for scientific measurements (handling of significant digits, operations with significant digits, etc).
- Techniques for extraction movement features from full-body 3D trajectories (curvature, sphericity, and so on), developed as EyesWeb XMI modules.

- Techniques for extraction movement features from users playing a music keyboard, developed as EyesWeb XMI modules.
- Techniques for real-time analysis of Laban's Effort on 3D full-body mocap data, developed as EyesWeb XMI applications.
- Techniques for computation and adaption of models of the motoric behaviour of the child in terms of Laban's effort qualities, developed as EyesWeb XMI modules and applications.
- Methodology and techniques for real-time cross-modal reflexive dialogue, developed as EyesWeb XMI and MetaEyesWeb applications.
- A MetaEyesWeb template for developing applications involving cross-modal interaction with stories or non-linear structures.

NKUA Research areas include the following: teacher music education, community music therapy, music therapy, school music education and curricula, computational music analysis, creativity. In particular:

- Designing and implementing pedagogical processes of learning to improvise for teacher education in university curricula.
- Designing and implementing community music therapy and music therapy interventions.
- Follow up studies using MIROR COMPO in schools.
- In collaboration with the Department of Psychiatry at the University of Athens, cognitive neuroscience experiments using ECT scans while using MIROR IMPRO.
- Continue developing the methodology and system for the computational music analysis of MIROR IMPRO (PhD thesis of Antonis Alexakis).
- Possible book publication

4.1.6. The address of the project public website

Relevant information and updates about the MIROR activity can be found at the project URL:

www.mirorproject.eu

The MIROR newsletter will be sent periodically in order to update the MIROR community about the last and near future events, studies, results, proposals, and publications. You can subscribe to the MIROR newsletter by means the project URL.

The MIROR wiki-portal has been activated: http://mirorwiki.eu.

4.2 Use and dissemination of foreground

Section A (public)
The list of scientific publications is summarised in the following table.

TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS										
NO.	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers[8] (if available)	Is/Will open access[9] provided to this publication?
1	Exploring turn-taking in children's interaction with a new music technology.	Wallerstedt, C.	He Kupu	2(5)			2011	20-31		yes
2	'Here comes the sausage': An empirical study of children's verbal communication during a collaborative	Wallerstedt, C.	Music Education Research		Routledge		2013		DOI:10.1080/14613808.2013.812626	no

[8] A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).
[9] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

	music-making activity									
3	Experiencing and creating contrasts in music	Wallerstedt, C.	International Journal for Lesson and Learning studies		Emerald		Accepted /2014			no
4	*'A computational* method for exploring musical creativity development'	*Alexakis, A., Khatchatourov, A., Triantafyllaki, A. & Anagnostopoulou, C.*	*Sound and Music Computing (SMC)* Conference Proceedings			*Stockholm, Sweden*	*2013*		http://smcnetwork.org/resources/smc_papers (when available)	yes
5	*A Computational Method for the* Analysis of Musical Improvisations by Young Children and Psychiatric Patients with No Musical Background.	*Anagnostopoulou, C., Alexakis, A. & Triantafyllaki, A.*	*E.Cambouropoulos et al (eds) Proceedings of the ICMPC-ESCOM International* Conference,			*Thessaloniki, Greece*	*2012*		http://icmpc-escom2012.web.auth.gr/?q=node/67	yes
6	*The Reflexion of Psychiatric* Semiology on Musical Improvisation: A case study of a patient diagnosed with Obsessive Compulsive Disorder.	*Dakovanou, X., Anagnostopoulou, C, & Triantafyllaki, A.*	*E.Cambouropoulos et al (eds) Proceedings of the ICMPC-ESCOM International Conference,*			*Thessaloniki, Greece*	*2012*		http://icmpc-escom2012.web.auth.gr/?q=node/67	yes
7	*An Exploratory Study of Young*	*Triantafyllaki, A.,*	*E.Cambouropoulos et al (eds) Proceedings of*			*Thessaloniki, Greece*	*2012*		http://icmpc-	yes

	Children's Technology-Enabled Improvisations.	*Anagnostopoulou, C. & Alexakis, A.*	*the ICMPC-ESCOM International Conference,*						escom2012.web.auth.gr/?q=node/67	
8	*Is it playing my tune? Young pianists improvising with reflexive* music technology.	*Rowe, V. & Triantafyllaki, A.*	*RIME Conference Proceedings*			*Exeter, Greece*	*2012*		http://socialsciences.exeter.ac.uk/media/universityofexeter/collegeofsocialsciencesandinternationalstudies/education/research/rime/RIME_Abstracts&Summaries_Final.pdf	yes
9	*Young pianists exploring improvisation using interactive music technology*	*Rowe, V., Triantafyllaki, A. & Anagnostopoulou, C.*	*Submitted to IJME (under review)*							
10	*Learning about Composing in a Greek Primary School using* New Music Technology	*Triantafyllaki, A & Anagnostopoulou*	*In preparation*							
11	*Analysing children's keyboard improvisations*	*Anagnostopoulou, C., Alexakis, A.,*	*In preparation for JNMR*							

		Triantafyllaki, A. and Pachet F.								
12	*Finite-Length Markov Processes with Constraints*	Pachet, F., Roy, P., Barbieri, G.	Proceedings of the 22nd International Joint Conference on Artificial Intelligence			Barcelona, Spain	July 2011	635-642	http://www.csl.sony.fr/bibdetails.php?reference=pachet:11b	yes
13	*Markov constraints: steerable generation of Markov sequences.*	Pachet, F. and Roy, P.	Constraints				March 2011	16(2):148-172		
14	*MIROR IMPRO and COMPO Software: the User Guide*	Khatchatourov, A. Pachet, F.	Sony Computer Science Laboratory Paris				July 2013		The JGuido Library: Real-Time Score Notation from Raw MIDI Inputs	yes
15	*The JGuido Library: Java API.*	Fober, D., Pachet, F.	Sony Computer Science Laboratory Paris				July 2013		http://www.csl.sony.fr/downloads/papers/2013/fober-13b.pdf	yes
16	*The JGuido Library: Real-Time Score Notation from Raw MIDI Inputs*	Fober, D., Kilian, J.F., Pachet, F.	Sony Computer Science Laboratory Paris				July 2013		http://www.csl.sony.fr/bibdetails.php?reference=fober:13a	yes
17	THE FLOW GRID: A Technique for Observing and Measuring Emotional	Addessi, A.R., Ferrari, L., Carugati, F.	Journal of New Music Research				Forthcoming			

	State in Children Interacting with a Flow Machine									
18	Founding a systematic perspective of the reflexive interaction paradigm. From Echo to the mirror neurons	Addessi, A.R.	Psychomusicology				Forthcoming			
19	A new way to play music together: The continuator in the classroom	Ferrari, L., Addessi, A.R.	International Journal of Music Education (Practice)				In print			
20	Child/machine interaction in reflexive environment. The MIROR platform	Addessi, A.R.	In R. Bresin, (Ed). Proceedings of the Sound and Music Computing Conference 2013		Stockholm	Logos Verlag berlin GmbH	2013	95-102	http://www.mirorproject.eu/content/docup/SMACSMC2013_Addessi.pdf	yes
21	Early exploration of digital sound: Two-three year old children interacting with the MIROR IMPRO	Ferrari L., Addessi, A.R.	In J. Pitt and J. Retra (Eds), *MERYC2013. Proceedings of the 6th Conference of the European Network of Music Educators and Researchers of Young Children*		The Hague:	Gehrels Muziekeducatie	2013	359-368	http://www.mirorproject.eu/content/docup/Ferrari&Addessi_MERYC2013.pdf	yes

22	The MIROR-Body Gesture: Designing a reflexive system for children. A pilot study on Laban's Effort features	Addessi, A.R., Cardoso de Arujo, R., Maffioli, M., Regazzi, F., & Volpe, G., Mazarino, B, VArni, G:	In V.C. Marques & M. Moreira (Eds), *Anais do IX Simpósio de cognição e artes musicais (internacional*		Belém, Brazil	Escola de Musica da Universida de Federal du Pará,	2013			yes
23	Children's musical improvisation in an interactive/reflexive musical context	Cardoso De Araujo, R. , Addessi, A.R.,	In V.C. Marques & M. Moreira (Eds), *Anais do IX Simpósio de cognição e artes musicais (internacional*		Belém, Brazil	Escola de Musica da Universida de Federal du Pará,	2013	21-31	http://www.mirorproject.eu/content/docup/SimCam_CArdoso%20Addessi,%202013.Definit.pdf	yes
24	Observing Flow in child/music machine interaction.	Addessi, A.R., Ferrari, L.	In A.J. Spink, et Al. (Eds), *Proceedings of 8th International Conference on Methods and Techniques in Behavioral Research (Measuring Behavior 2012)*		Utrecht, The Netherlands,		2012	324-327	http://www.mirorproject.eu/content/docup/Addessi,Ferrari,Carugati_Measuring_Behavior_Conference.pdf	yes
25	From Echo to the mirror neurons: Founding a systematic perspective of the reflexive interaction paradigm	Addessi, A.R.	In E. Cambouropoulos, C. Tsougras, P. Mavromatis, & K. Pastiadis (Eds.), *Proceedings of the 12nd ICMPC and the 8th Triennial Conference of ESCOM*		Thessaloniki, Greece,		2012	9-19	http://www.mirorproject.eu/content/docup/ICMPC-ESCOM2012_Reflexive%20interaction.	yes

									pdf	
26	Children observing and measuring the flow emotional state in children interacting with the MIROR platform	Addessi, A.R., Ferrari, L., Carugati, F.	In E. Cambouropoulos, C. Tsougras, P. Mavromatis, & K. Pastiadis (Eds.), *Proceedings of the 12nd ICMPC and the 8th Triennial Conference of ESCOM*		Thessaloniki, Greece,		2012	20-30	http://www.mirorproject.eu/content/docup/ICMPC-ESCOM2012_Flow.pdf	yes
27	Children music-making with interactive reflexive technology. A case study of spiral method of specification	Addessi, A.R., Volpe, G., Varni, G., Newman, S.	eChallenges e-2012 Conference Proceedings		Lisbon, Portugal	IIMC-International Infromation Management Corporation	2012	1-13	http://www.mirorproject.eu/content/docup/eChallenges2012_Addessi%20et%20Al..pdf	yes
28	The MIROR Project.	Addessi, A.R., Volpe, G.	In C. Delgados Kloos et Al. (Eds), *Towards Ubiquitous Learning. Proceedings of the Sixth European Conference on Technology Enhanced Learning* (EC-TEL 2011)			Springer Verlag	2011	15-28	http://www.mirorproject.eu/content/docup/MIROR_at_EC-TEL2011-Proocedings.pdf	yes
29	The MIROR Project: Music interaction relaying on reflexion.	Addessi, A.R., Ferrari L., Young S.	In S. Young (Ed.), MERYC2011. Proceedings		Helsinki, Finland		2011	27-32	http://www.mirorproject.eu/content/docup/MIROR_at_MERYC2011.pdf	yes

30	The MIROR Project	Addessi A.R., Ferrari	In T. Minerva & L. Colazzo (eds), 7th Congresso Nazionale della Società Italiana di e-Learning (SIEL)		Reggio Emilia	L'Edizioni	2011	15-25	http://www.mirorproject.eu/content/docup/MIROR_at%208SIe-L.2011.pdf	yes
31	Does the reflexive interaction enhance musical dialogue and creativity? The MIROR Platform at the beginning stages of learning musical improvisation	Addessi, Anelli, Benghi	In preparation							
32	Children dancing with MIROR IMPRO. Does the reflexive interaction enhance movement creativity?	Addessi A.R., Anelli F., Maffioli M.	In preparation							
33	MIROR focus group. Exploring relfexive technologies with university students of educational sciences	Addessi A.R., Anelli F., Bonfiglioli L., Romagnoli	In preparation							
34	Music technology in music therapy with children. A pilot study with the MIROR platform, an adaptive system based on the reflexive interaction paradigm	Bonfiglioli L., Addessi A. R.	In preparation							
35	Embodied music	Anelli F.,	In preparation							

	cognition and reflexive interaction	Borghi, Addessi A.R.								
36	La creatività del bambino: dal movimento alla danza	Maffioli, Anelli, Addessi	In preparation							
37	Children's improvisation with the MIROR system: free vs guided exploration	Luc Nijs, Addessi AR	In preparation							
38	Special Issue of Musicae Scientiae	Addessi and Volpe (Eds), + All Partners	In preparation							

The project partners attended the following International and National Conferences and Seminars to present the MIROR Project: its characteristics; the theoretical background; the objectives; partners and structure. These relevant international conferences have been also targeted with the aim of spreading research results obtained within MIROR and giving visibility to the MIROR project among the EU Community. The papers of the oral presentations have been published in the Proceedings of scientific events. Table A2 presents an overview of the presentations relevant to the MIROR project conducted in the whole duration of the project.

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES								
NO.	Type of activities[10]	Main leader	Title	Date/Period	Place	Type of audience[11]	Size of audience	Countries addressed
1	Conf. Present.	UGOT	Exploring musical play in 6-year-old children and an adult interacting with and around a music technology	January 4, 2012	Malmö, Sweden	teachers, school leaders, researchers and policy-makers from around the world	50	International

[10] A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.

[11] A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).

2	Lecture	UGOT	Children's music development and the new music technology called MIROR Project - Music Interaction Relying On Reflexion	May 7-11, 2012	Reykjavik, Iceland	Researchers& Master/PhD students	60	Iceland, Sweden, Australia
3	Conf. Present.	UGOT & UNIBO	Musical interaction of reflexion (MIROR) some tentative results of a European research project.	Feb.14-17 2012	Reykjavik, Iceland	Senior researchers, PHD-students	40	The Nordic countries
4	Conf. Present. as part of self-organized symposium	UGOT	Musical play in 6-year-old children and an adult interacting with and around a new music technology.	28-31 August 2013	Tallinn, Estonia.	Senior researchers, PHD-students, practioners		International
5	Poster Present.	UNIGE & UNIBO	BeSound: Embodied Reflexion for Music Education in Childhood	June 12-15, 2012	Bremen, Germany	Scientific	200	Internat.
6	Conf. Present.	UNIGE	Towards real-time affect detection based on Sample	Oct.	Memphis, TE, USA	Scientific	200	Internat.

			Entropy analysis of expressive gesture	2011				
7	Present.	UNIGE	Presentation of the MIROR Project	Oct. 2011	Jyväskylä, Finland	Scientific	30	Internat.
8	Present. & Demo	UNIGE (with UNIBO collaboration)	Presentation of the MIROR Project	Oct. 2011	Genova, Italy	General audience (experts and non experts)	1000	Mainly Italy
9	Conf. Present.	UNEXE & UNIBO	The MIROR Project	June 8-11, 2011	Metropolia University of Applied Sciences, Helsinki, Finland.	Scientific	200	Internat.
10	Workshop	UNEXE	Workshop presentation; MIROR technologies	23 January 2012	MAC Arts Centre, Birmingham, England	Music education and early childhood education	200	National

11	Conf. Present.	UNEXE	Young children's improvisations on a keyboard: How might reflexive technologies support the processes of learning to improvise?	23-28 July 2012	Thessaloniki, Greece	Scientific	1000	Internat.
12	Present.	UNEXE	The MIROR project UNEXE has given a number of invited keynote presentations to professional and academic audiences during the past two years, which have included brief information and details of the MIROR project as appropriate to the audience and context.	2011-2012	5th February 2011, Mechelen Belgium; 28th November 2011, Antwerp, Belgium; 23rd January, Birmingham, England; 28th April, University of Roehampton, London, England; 22nd June, 2012, Great Yarmouth, England			
13	Present.	UNEXE	Young Pianists Composing with Interactive Music	15 September, 2012	Institute of Education,	Academic/Scientific	30	International

			Software		London			
14	Present.	UNEXE & NKUA	Is it playing my tune? Young pianists improvising with reflexive music technology	9-13 April 2013.	Exeter, UK	Academic/Scientific	150	Internat.
15	Invited present	UNEXE	MIROR Workshop	4 June 2013	Manchester UK	University Education Students	30	British
16	Invited talk	UNIBO	"Dalle idee al finanziamento: percorsi di successo per UNIBO".(From ideas to grant: successful paths of UNIBO)	March 25, 2010	University of Bologna, Italy	Academic/Scientific	100	Mainly Italy
17	Present.	UNIBO	The MIROR Project: Music Interaction Relying on Reflexion	May 24-27, 2011	Universidade de Brasilia, Brasilia, Brasil	Scientific/Academic	90	Internat.
18	Lecturer	UNIBO	The MIROR Project: an European project co-funded by the European Community	June 11, 2011	Universidade Federal de Bahia, Salvador de Bahia, Scola de Musica,	Postgraduate students/ Academic	20	National (Brazilian)

					Brazil			
19	Oral presentation	UNIBO	Progetto MIROR. Il primo anno	Sept 14-16, 2011	University of Modena and Reggio Emilia, Italy	Scientific	150	National (mainly Italy)
20	Video interview	UNIBO	Research in Musicology at the University of Bologna	September 2011	http://www.youtube.com/user/nottedeiricercatori#p/u/16/TGbZxEWAc3Q	Scientific and public dissemination	1000	International (Mainly Italy)
21	Invited talk	UNIBO	Bambini, musica e interazione riflessiva.	11/02/12	Bologna, Italy Organised by University of Bologna and Fondazione Golinelli,	Scientific and public dissemination	20	International (Mainly Italy)
22	Poster	UNIBO	MIROR project: Musical Interaction Relying on Reflexion	January/February 2012	Exposition in Piazza Maggiore, Bologna, Italy Organised by University of Bologna and	Scientific and public dissemination	1000	International (Mainly Italy)

					Fondazione Golinelli			
23	Invited talk	UNIBO	The MIROR Project	13 and 14/03/2012	Milan and Padua, Italy	Scientific	50	International
24	Conf.Present. & DEMO (video)	UNIBO & UNIGE	The MIROR Project at the first year: outcomes and experiments". Title of DEMO-Video: "Experiments with children and MIROR IMPRO prototype	Sept. 20-23, 2011	Palermo, Italy	Scientific	300	Internat.
25	Conf. Present.	UNIBO	The MIROR platform: the first protocol with MIROR IMPRO prototype	Oct. 26-29, 2011	University of Boston, Boston, USA.	Scientific	60	International
26	Conf. Present.	UNIBO	A study about children's musical improvisation in an interactive reflexive musical context	July 15-20, 2012	Thessaloniki, Greece	Scientific	600	Internat.

27	Conf. Present.	UNIBO	From Eco to the Mirror Neurons: Founding a Systematic Perspective of the Reflexive Interaction Paradigm	23-28 July, 2012	Thessaloniki, Greece	Scientific	600	Internat.
28	Poster	UNIBO	Observing and Measuring the Flow Emotional State in Children interacting with the MIROR platform					
29	Conf. Present.	UNIBO	Observing Flow in child/music machine interaction	Aug. 28-31, 2012	Utrecht, The Netherlands	Scientific	200	Internat.
30	Conf. Present.	UNIBO, UNIGE & COMPEDIA	Children music-maker with the interactive reflexive technology	Oct. 17-19, 2012	Lisbon, Portugal	Scientific		Internat.
31	Lectures	UNIBO	Presentation of MIROR Project: theoretical	14 August 2012	University of Parana-Curitiba, University of	Graduate and post graduate, Phd students,	100	National (Brazilian)

			framework and empirical applications	21 August 2012 30 August 2012	Brasilia,-Brasilia Universitiy of Bahia-Salvador	Higher teacher education students/Academics.		
32	Invited talk	UNIBO	"La piattaforma MIROR: un nuovo 'dispositivo' per la creazione musicale e motoria. Background teorico, architettura e sperimentazioni" ("MIROR platform: a new "device" to enhance musical and gesture creativity. Theoretical background, structure and experimental protocols.	26-27/10/2012	Rome, Italy.	Academic, educators, therapists	200	international

33	Conf. Present.	UNIBO	Early exploration of digital sound: Two–three years old children interacting with the MIROR IMPRO.	July 17–20, 2013	the Hague, Netherlands	Academic and Practice	Less than 100	Internat. European
34	Oral presentation	UNIBO	The MIROR Project	22 November 2012	IPEM, University of Ghent	Academic, PhD students	10	
35	Invited talk	UNIBO	Child/machine interaction in reflexive environment. The MIROR platform	July 30-August 3 2013	University of Stockholm, Royal Institute of Technology (SMC2013)	Academic, Scientific, PhD students	300	Intern.
36	Oral talk	UNIBO/ Univ. of Curitiba	Designing the MIROR Body Gesture	May 27-30 2013	University of Para, Belém, Brazil	Academic, educators, therapists	100	International
37	Oral talk	UNIBO/ Univ. of Curitiba	Children's musical improvisation in an interactive/reflexive musical context: An study.	May 27-30 2013	University of Para, Belém, Brazil	Academic, educators, therapists	100	International
38	Workshop	UNIBO/IPEM, Ghent	Workshop+Debriefing	July 2013	The Hague University	Academic Educators, therapists	15	international

39	Oral presentation	UNIBO	Introduction to the MIROR project	July 2013	The Hague University	Academic, educators, tharpists	100	international
40	Conf. Present.	NKUA	An Exploratory Study of Young Children's Technology-Enabled Improvisations	July 23-28, 2012	Thessaloniki, Greece	Scientific	600	Internat.
41	Poster	NKUA	A Computational Method for the Analysis of Musical Improvisations by Young Children and Psychiatric Patients with No Musical Background					
42		NKUA	The Reflexion of Psychiatric Semiology on Musical Improvisation: A case study of a patient diagnosed with Obsessive Compulsive Disorder					

43	Poster	NKUA	Analysing children's improvisations during child-machine interactions	September 10-13, 2012	Oxford University, U.K.	Scientific	200	International
44	Conf. Present.	NKUA	Learning to compose using interactive technology: A case study investigation of young children's collaborative composition processes using the MIROR Platform	April 9-13, 2013	Exeter, UK	Scientific	400	International
45		NKUA + UNIEXE (primary author)	Is it playing my tune? Young pianists improvising with reflexive music technology.					
46	Poster	NKUA (primary author) + SONY	A computational method for exploring musical creativity development	July 30- August 2, 2013	Stockholm, Sweden	Scientific	300	International

47	Invited talk	NKUA	New technologies in music education: The European Programme MIROR (Musical Interaction Relying on Reflexion)	June 20, 2013	Athens, Greece	Public	100	Regional
48	Invited discussion	NKUA	MIROR (Musical Interaction Relying on Reflexion)	August 22-23, 2013	Rethymno, Crete	Scientific		Regional
49	Conf. Present.	UGOT	Musical Play in 6-Year-Old Children and an Adult Interacting with and Around a New Music Technology.	August. 2013	Tallinn, Estonia	Scientific		International
50	Invited talk	UGOT	Att dela en musikalisk upplevelse som lärandeaspekt i förskolan. ”To share a musical experience as an aspect of learning in preschool”	23 August, 2013.	Malmö, Sweden	Scientific/teachers	30	National (Sweden)
51	Invited talk	UNIBO	Inspiration and improvisation. Reflexive interaction in music education and new technology	April 2013.	Tallinn Univeristy, Music Department	Scientific/teachers	50	International

52	Invited talk	UNIBO	The MIROR project	11-12 August, 2013.	Ryerson University Toronto, Canada (AIRS-Advance Interdisciplinary Research on Singing, 5th Meeting)	Academic, Scientific , PhD students	60	International
53	Oral presentations, workshop, demonstrations, focus group, usability test	UNIBO, UNEXE, ALB members (Dr Nijs, MERYC)	The MIROR Summer School	17-19 July 2013	The Hague University	Academic, teachers, researchers, PhD students	30	European

Section B (Confidential[12] or public: confidential information to be marked clearly)
Part B1

TEMPLATE B1: LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS, ETC.					
Type of IP Rights[13]:	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant (s) (as on the application)

None.

[12] Note to be confused with the "EU CONFIDENTIAL" classification for some security research projects.

[13] A drop down list allows choosing the type of IP rights: Patents, Trademarks, Registered designs, Utility models, Others.

Part B2

The exploitable foreground produced within the MIROR project is summarised in the table below:

Type of Exploitable Foreground[14]	**Description of exploitable foreground**	**Confidential Click on YES/NO**	**Foreseen embargo date dd/mm/yyyy**	**Exploitable product(s) or measure(s)**	**Sector(s) of application**[15]	**Timetable, commercial or any other use**	**Patents or other IPR exploitation (licences)**	**Owner & Other Beneficiary(s) involved**
Algorithm for generating Markov chains satisfying unary constraints ➔ Constrained Markov Processes		Yes			Education, performing arts, health, sport,	After the end of the project	Pending	SONY CSL
Application for real-time generation of improvisation in the style of the user ➔ MIROR IMPRO application		Yes			Education, performing arts, health, sport,	After the end of the project		SONY CSL
Application for off-line generation of		Yes			Education,	After the end of		SONY CSL

[19] A drop down list allows choosing the type of foreground: General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation.

[15] A drop down list allows choosing the type sector (NACE nomenclature) : http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

Type of Exploitable Foreground[14]	**Description of exploitable foreground**	**Confidential Click on YES/NO**	**Foreseen embargo date dd/mm/yyyy**	**Exploitable product(s) or measure(s)**	**Sector(s) of application**[15]	**Timetable, commercial or any other use**	**Patents or other IPR exploitation (licences)**	**Owner & Other Beneficiary(s) involved**
compositions in the style of the user ➔ MIROR COMPO application					performing arts, health, sport,	the project		
MidiShare 32-64 ➔ real-time musical MIDI operating system, providing high level services to the field of computer music and MIDI applications.		Yes			Musical software handling MIDI signal.	After the end of the project		GRAME / SONY CSL
JGuido and GlnToGmn Library *Ies* ➔ Full-fledged *musical score notation* display, which handles realtime,		Yes			Score visualisation	After the end of the project		SONY CSL / Jürgen Kilian

Type of Exploitable Foreground[14]	**Description of exploitable foreground**	**Confidential Click on YES/NO**	**Foreseen embargo date dd/mm/yyyy**	**Exploitable product(s) or measure(s)**	**Sector(s) of application**[15]	**Timetable, commercial or any other use**	**Patents or other IPR exploitation (licences)**	**Owner & Other Beneficiary(s) involved**
arbitrary MIDI inputs								
"Style game" experiment ➔ Analysis of preservation of individual musical style (principle of comparison between human and machine generated melodies)		Yes			Education, performing arts, health, sport,	After the end of the project		SONY CSL
The concept of MIROR platform as a learning/teaching/research virtual environment exploiting the reflexive interaction paradigm not only in music improvisation		Yes			Education Creativity Performance Creative industry School of Music School of dance	After the end of the project	Copyright, Design	UNIBO

Type of Exploitable Foreground[14]	Description of exploitable foreground	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application[15]	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved
education but also in the field of body gesture analysis and potentially in other learning/teaching fields (as from figure 3 in D5.2, Chapter IV-UNIBO contribution, and A.R. Addessi, "Child/Machine interaction in reflexive environment. The MIROR Platform", Proceedings of SMAC/SMC 2013 Conference, Stockholm July 2013)					Hospital Kinder centre Home and family Arts Therapy Research tools			

Type of Exploitable Foreground[14]	**Description of exploitable foreground**	**Confidential Click on YES/NO**	**Foreseen embargo date dd/mm/yyyy**	**Exploitable product(s) or measure(s)**	**Sector(s) of application**[15]	**Timetable, commercial or any other use**	**Patents or other IPR exploitation (licences)**	**Owner & Other Beneficiary(s) involved**
MIROR theoretical framework (D2.2.1 revised, D5.1, D5.2, D6.1)								UNIBO, UNEXE, NKUA, UGOT, UNIGE, SONY
User's and Teacher's Guides (D6.2)		yes			Pedagogical guide and practices for the MIROR target groups: children, generalist teachers and practitioners (nursery, kindergarten, primary school), music teachers, dance teachers, therapists, parents, teacher educators, caregivers, etc. ,	after the end of the Project	Copyright	UNIBO (50%), UNEXE (20%) , NKUA (20%) and UGOT (10%)

Type of Exploitable Foreground[14]	**Description of exploitable foreground**	**Confidential Click on YES/NO**	**Foreseen embargo date dd/mm/yyyy**	**Exploitable product(s) or measure(s)**	**Sector(s) of application**[15]	**Timetable, commercial or any other use**	**Patents or other IPR exploitation (licences)**	**Owner & Other Beneficiary(s) involved**
IMPRO and COMPO software Manual (D4.1.2 and D4.2.2)		Yes				After the end of the Project	Copyright	SONY CSL
Body Gesture software Manual (D4.3.2)								UNIGE
Observational Grids created with the software OBSERVER (Noldus): 6. Flow grid 7. Laban grid 8. Listening grid		yes			Research methodology and tool. Education, Creative Industry, Arts Therapy	After the end of the Project	Copyright	UNIBO
Logo MIROR Project		NO			Education Creative Industry	During and after the end of the Project	Trademark	UNIBO

Type of Exploitable Foreground[14]	**Description of exploitable foreground**	**Confidential Click on YES/NO**	**Foreseen embargo date dd/mm/yyyy**	**Exploitable product(s) or measure(s)**	**Sector(s) of application**[15]	**Timetable, commercial or any other use**	**Patents or other IPR exploitation (licences)**	**Owner & Other Beneficiary(s) involved**
Techniques for movement analysis, included in the EyesWeb Gesture Processing Library Software modules are included in the library as long as they are developed		makes the EyesWeb Gesture Processing Library publicly available for research purposes			Education, performing arts, health, sport, ...			UNIGE

Type of Exploitable Foreground[14]	**Description of exploitable foreground**	**Confidential Click on YES/NO**	**Foreseen embargo date dd/mm/yyyy**	**Exploitable product(s) or measure(s)**	**Sector(s) of application**[15]	**Timetable, commercial or any other use**	**Patents or other IPR exploitation (licences)**	**Owner & Other Beneficiary(s) involved**
MIROR Body-Gesture_Potter Workshop application		Depending on possible commercial exploitation. UNIGE is anyway available for broad dissemination			Education	After the end of the project		UNIGE
MIROR-Body		Depending on			Education	After the end of		UNIGE

Type of Exploitable Foreground[14]	**Description of exploitable foreground**	**Confidential Click on YES/NO**	**Foreseen embargo date dd/mm/yyyy**	**Exploitable product(s) or measure(s)**	**Sector(s) of application**[15]	**Timetable, commercial or any other use**	**Patents or other IPR exploitation (licences)**	**Owner & Other Beneficiary(s) involved**
Gesture_BeSound		possible commercial exploitation. UNIGE is anyway available for broad dissemination				the Project		
MIROR WIKI portal						After the end of the Project	Copyright	COMPEDIA (80%), UNIBO (20%)
MIROR Web Site						During and after the end of the	Copyright	UNIBO

Type of Exploitable Foreground[14]	**Description of exploitable foreground**	**Confidential Click on YES/NO**	**Foreseen embargo date dd/mm/yyyy**	**Exploitable product(s) or measure(s)**	**Sector(s) of application**[15]	**Timetable, commercial or any other use**	**Patents or other IPR exploitation (licences)**	**Owner & Other Beneficiary(s) involved**
						project		
Library to generate MP3 files from recorded MIDI IMPRO/COMPO sessions		Yes			Education, performing arts, health, sport,	After the end of the project		SONY CSL
MidiShare to Fluidsynth bridge /Library, allowing to generate audio without windows built-in synthesizer		Yes			Education, performing arts, health, sport,	After the end of the project		SONY CSL
Library allowing to upload and manage IMPRO / COMPO user session on a distant server		Yes			Education, performing arts, health, sport	After the end of the project		SONY CSL

Type of Exploitable Foreground[14]	**Description of exploitable foreground**	**Confidential Click on YES/NO**	**Foreseen embargo date dd/mm/yyyy**	**Exploitable product(s) or measure(s)**	**Sector(s) of application**[15]	**Timetable, commercial or any other use**	**Patents or other IPR exploitation (licences)**	**Owner & Other Beneficiary(s) involved**
IMPRO / COMPO User Guides and associated documentation.		Yes			Education, performing arts, health, sport	After the end of the project		SONY CSL

The expected final results of the project are fully functional MIROR prototypes, assessed with experiments with children and grounded on solid theoretical bases. Impact is expected on education and learning, starting from music education, but possibly extending to other fields. Moreover, MIROR aims to:

- Develop a detailed analysis aimed at assessing the impact of the reflexive interaction paradigm on both music learning and general cognitive/learning processes.
- Promote an active approach to musical culture, based on a "music-making" concept, rather than "music-consuming"; promote the use of the MIROR platform in children and adults, enabling a wider access to music by experts as well as non experts; enhance the diffusion of music culture in EU society through experiments with the MIROR platform in several European countries; produce a User Guide and a Teachers' Guide.

In particular, the Consortium planned the Exploitation Academic plan, which includes the following *Sectors of research activities*

UNIBO research areas include the following: Child/machine interaction, technology enhanced learning, e-learning, reflexive interaction and creativity, children's music improvisation and composition, teacher education, music therapy, embodied music cognition, dance education, artistic performance, evolution of music language, vocal child/adult interaction, singing development in children. In particular the UNIBO team is planning to fully realise the MIROR Pedagogical Framework by implementing the missing parts of the MIROR platform, i.e., the learning/teaching modules for using the three software applications (MIROR IMPRO, MIROR COMPO and MIROR Body Gesture): the

users'/teachers'/researchers' interfaces; the learning-objects for teachers, music therapists, children of different ages, music teachers, dance educators, tutors' facilitators, teachers' training tools, etc.; the two data bases (Children_Log -, for teachers: to upload interesting children compositions, improvisations and choreographies. Work in progress, for researchers: to upload interesting practices, experiments and videos, documenting the research work in progress).

In particular, UNIBO will exploit the following knowledge:

- The concept of MIROR platform as a learning/teaching/research virtual environment exploiting the reflexive interaction paradigm not only in music improvisation education but also in the field of body gesture analysis and potentially in other learning/teaching fields (as from figure 3 in D5.2, Chapter IV-UNIBO contribution).
- The design and implementation of pedagogical processes and guides for teachers and children to be used with MIROR applications (D6.2)
- The theoretical framework of reflexive interaction paradigm for educational purposes (D2.2.1, UNIBO contribution)
- Experimental protocols: Protocol no 1 and no2 of DoW, protocol Body-Impro. Protocol in music-therapy setting
- Flow grid by software Observer
- Laban grid by software Observer
- Listening grid by software Observer
- Grid of Sound/Movement connection, for MIROR-Body Gesture
- Grid with Modes of Dialogue, for MIROR-Body Gesture
- "Duets" grid, for the observation of musical dialogue between 2 children, by software Observer.

SONY Research areas include the following:

- [ACM Computing Classification System, 1998 H.5.2.] Information interfaces and representation: User interfaces – Interaction styles, user-centred design, auditory feedback.
- [ACM Computing Classification System, 1998] K.3.1. (Computers and education): Computer uses in education – computer assisted instruction.
- [Other sectors] Child/machine interaction; technology enhanced learning, e-learning, reflexive pedagogy, teacher education, music therapy, embodied music cognition, performing arts, sport, score visualisation, musical software handling MIDI signal.

In particular SONY will exploit the following knowledge:

- Constrained Markov Processes: Algorithm for generating Markov chains satisfying unary constraints.
- MIROR IMPRO application: Application for real-time generation of improvisation in the style of the user.

- MIROR COMPO application: Application for off-line generation of compositions in the style of the user.
- MidiShare 32-64: real-time musical MIDI operating system, providing high level services to the field of computer music and MIDI applications.
- JGuido and GlnToGmn Libraries: Full-fledged musical score notation display, which handles realtime, arbitrary MIDI inputs.
- "Style game" experiment: Analysis of preservation of individual musical style (principle of comparison between human and machine generated melodies).

UNIGE Research areas include the following (ACM Computing Classification System, 1998):
H.5.2. Information interfaces and representation: User interfaces – Interaction styles, user-centred design, auditory feedback
K.3.1. (Computers and education): Computer uses in education – computer assisted instruction.
In particular, UNIGE will exploit the following knowledge:

- Annotated archive of children performing selected gestures according to different Laban effort qualities
- EyesWeb applications for synchronised recordings of video and mocap
- Extensions to EyesWeb XMI making a EyesWeb platform for scientific measurements (handling of significant digits, operations with significant digits, etc)
- Techniques for extraction movement features from full-body 3D trajectories (curvature, sphericity, and so on), developed as EyesWeb XMI modules
- Techniques for extraction movement features from users playing a music keyboard, developed as EyesWeb XMI modules
- Techniques for real-time analysis of Laban's Effort on 3D full-body mocap data, developed as EyesWeb XMI applications
- Techniques for computation and adaption of models of the motoric behaviour of the child in terms of Laban's Effort qualities, developed as EyesWeb XMI modules and applications
- Methodology and techniques for real-time cross-modal reflexive dialogue, developed as EyesWeb XMI and MetaEyesWeb applications
- A MetaEyesWeb template for developing applications involving cross-modal interaction with stories or non-linear structures.

NKUA Research areas include the following: Teacher music education, community music therapy, music therapy, school music education and curricula, computational music analysis, creativity. In particular:

- Designing and implementing pedagogical processes of learning to improvise for teacher education in university curricula.
- Designing and implementing community music therapy and music therapy interventions.
- Follow up studies using MIROR COMPO in schools.

- In collaboration with the Department of Psychiatry at the University of Athens, cognitive neuroscience experiments using ECT scans while using MIROR IMPRO.
- Continue developing the methodology and system for the computational music analysis of MIROR IMPRO (PhD thesis of Antonis Alexakis).
- Possible book publication

4.3 Report on societal implications

A General Information *(completed automatically when **Grant Agreement number** is entered.*	
Grant Agreement Number:	258338
Title of Project:	Musical Interaction Relying On Reflexion
Name and Title of Coordinator:	Dr. Anna Rita Addessi

B Ethics	
1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	***No***
2. Please indicate whether your project involved any of the following issues (tick box) :	***YES***
RESEARCH ON HUMANS	
• Did the project involve children?	Yes
• Did the project involve patients?	Yes
• Did the project involve persons not able to give consent?	Yes (children)
• Did the project involve adult healthy volunteers?	No
• Did the project involve Human genetic material?	No
• Did the project involve Human biological samples?	No
• Did the project involve Human data collection?	Yes
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	No
• Did the project involve Human Foetal Tissue / Cells?	No
• Did the project involve Human Embryonic Stem Cells (hESCs)?	No
• Did the project on human Embryonic Stem Cells involve cells in culture?	No
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	No
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	No
• Did the project involve tracking the location or observation of people?	yes
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	no
• Were those animals transgenic small laboratory animals?	No
• Were those animals transgenic farm animals?	No
• Were those animals cloned farm animals?	No
• Were those animals non-human primates?	No
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc)?	**No**

• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	**Yes**
DUAL USE	
• Research having direct military use	0 Yes X No
• Research having the potential for terrorist abuse	no

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator	1	
Work package leaders	2 (4 WPS)	3 (3 WPs)
Experienced researchers (i.e. PhD holders)	3(Unibo); 2 (UNIGE); 3(UGOT); 3 (UNEXE 2 Experienced freelance research assistants (pedagogy, technology and music expertise and 1 research fellow – phd holder); 1 (COMPEDIA): 3 (NKUA); 1 (SONY)	2(Unibo); 4 (UNIGE); 2 (UGOT); 1 (NKUA); 3 (SONY)
PhD Students	1(UNIBO); 1 (UGOT)	1 (NKUA); 1 (SONY)
Other	4 (Unibo: teachers and master); 1(UGOT, master student); 2 (COMPEDIA); 4 (NKUA)	2 (UNIBO master, technician); 1 (UNEXE - Academic and technology expertise – freelance (PhD and university post); 2 (COMPEDIA); 1 (NKUA); 2 (SONY) (junior assistant researcher, master's degree, in-house consultant with no PhD)

4. How many additional researchers (in companies and universities) were recruited specifically for this project?

Of which, indicate the number of men:
UNEXE:3 – (2 [female] freelance musicians with expertise in teaching young children and music technology and 1 [male] academic with research and writing expertise in music technology in education)
COMPEDIA: 2, of which 1 man
SONY 7, of which 6 men

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project?	○ X	Yes No

6. Which of the following actions did you carry out and how effective were they?

		Not at all effective				Very effective
❑	Design and implement an equal opportunity policy	○	○	○	○	○
❑	Set targets to achieve a gender balance in the workforce	○	○	○	○	○
❑	Organise conferences and workshops on gender	○	○	○	○	○
❑	Actions to improve work-life balance	○	○	○	○	○
○	Other:					

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

○ Yes- please specify

X No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

x Yes- please specify : open days, presentations to parents, participation in science festivals, events, prizes

○ No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

x Yes- please specify : teacher's guide, educational practices, website

○ No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

x Main discipline[16]:

○ Associated discipline[16]: ○ Associated discipline[16]:

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)*	x ○	Yes No

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

○ No

x Yes- in determining what research should be performed

[16] Insert number from list below (Frascati Manual).

x	Yes - in implementing the research
x	Yes, in communicating /disseminating / using the results of the project

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	s ○	Yes No

12. Did you engage with government / public bodies or policy makers (including international organisations)

○	No
x	Yes- in framing the research agenda
x	Yes - in implementing the research agenda
x	Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

x	Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
x	Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
○	No

13b If Yes, in which fields?

Audiovisual and Media Consumers Culture Education, Training, Youth				Research and Innovation	

13c If Yes, at which level?

- x Local / regional levels
- x National level
- x European level
- x International level

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	
To how many of these is open access[17] provided?	**38**
How many of these are published in open access journals?	**20**
How many of these are published in open repositories?	**20**
To how many of these is open access not provided?	**2**
Please check all applicable reasons for not providing open access:	
❑ publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal X lack of time and resources ❑ lack of information on open access ❑ other[18]: ……	

15. How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*		**NONE**
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	**NONE**
	Registered design	**NONE**
	Other	**NONE**
17. How many spin-off companies were created / are planned as a direct result of the project?		**NONE**
Indicate the approximate number of additional jobs in these companies:		

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

❑	Increase in employment, or	❑	In small & medium-sized enterprises
❑	Safeguard employment, or	❑	In large companies
❑	Decrease in employment,	X	None of the above / not relevant to the project
❑	Difficult to estimate / not possible to quantify		

[17] Open Access is defined as free of charge access for anyone via Internet.
[18] For instance: classification for security project.

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:	*Indicate figure:*
3 for COMPEDIA 5,32 for SONY for the other partners difficult to estimate Difficult to estimate / not possible to quantify	

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

x Yes ○ No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

○ Yes x No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

❑	Press Release	❑	Coverage in specialist press
x	Media briefing	❑	Coverage in general (non-specialist) press
❑	TV coverage / report	❑	Coverage in national press
❑	Radio coverage / report	❑	Coverage in international press
x	Brochures /posters / flyers	x	Website for the general public / internet
x	DVD /Film /Multimedia	x	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

❑	Language of the coordinator	x	English
x	Other language(s)		

***Question F-10*:** Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES
1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]
1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)
1.3 Chemical sciences (chemistry, other allied subjects)
1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)
1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY

2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)
2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]
2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES
3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)
3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)
3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES
4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)
4.2 Veterinary medicine

5. SOCIAL SCIENCES
5.1 Psychology
5.2 Economics
5.3 Educational sciences (education and training and other allied subjects)
5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES
6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)
6.2 Languages and literature (ancient and modern)
6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]

PROJECT BRIEF SUMMARY

The **MIROR (Musical Interaction Relying On Reflexion) project** was a three-years project co-funded by the European Commission under the 7th Framework Programme, Theme ICT-2009.4.2, Technology-enhanced learning.

1. Consortium

1) Alma Mater Studiorum - Università di Bologna, Italy (UNIBO, Coordinator)
2) SONY, Computer Science Laboratory, Paris, France (SONY)
3) Università degli Studi di Genova, Italy (UNIGE)
4) Goeteborgs Universitet, Sweden (UGOT)
5) National and Kapodistrian University of Athens, Greece (NKUA)
6) The University of Exeter, United Kingdom (UNEXE
7) Compedia Software & Hardware Development Ltd., Israel (COMPEDIA)

The Advisory and Liaison Board was composed of relevant associations and individual scholars.

2. Concept

The MIROR Project dealt with the development of the MIROR platform, an adaptive system for music learning and teaching based on the "*reflexive interaction*" paradigm. The system was developed in the context of early childhood music and dance education. It acts as an advanced cognitive tutor, designed to promote specific cognitive abilities in the field of music improvisation, composition and body performance, both in formal learning contexts (kindergartens, primary schools, music schools) and informal ones (at home, kinder centres, etc.).
The reflexive interaction paradigm is based on the idea of letting users manipulate virtual copies of themselves, through specifically designed machine-learning software referred to as "Interactive Reflexive Musical Systems" (IRMS). In MIROR the IRMS paradigm was extended with the analysis and synthesis of multisensory expressive gesture to increase its impact on the musical pedagogy of young children.

3. Objectives

MIROR's primary goals were:

- The design and implementation of three MIROR applications:
  - The MIROR-Improvisation prototype (MIROR-Impro), addressing music improvisation.
  - The MIROR-Composition prototype (MIROR-Compo), addressing music composition.
  - The MIROR-Body Gesture prototype (MIROR-Body Gesture), exploring music and movement creativity.
- The implementation of psychological experiments aimed at investigating child/machine interaction in the reflexive environment.
- The definition of the theoretical framework of the reflexive interaction paradigm.
- The integration of the reflexive interaction paradigm with "embodied music cognition" framework.
- The validation of the MIROR applications in educational and therapeutic scenarios.
- The implementation of market analysis and the design of the industrial exploitation plan for the MIROR applications.

4. Methodology

The project was based on a spiral design approach involving coupled interactions between technical and psycho-pedagogical partners.

5. Work performed

UNIBO, UGOT, NKUA, and UNEXE (psycho-pedagogical partners) carried out a vast number of psychological and pedagogical experiments in order to implement the 3 applications - MIROR-Impro, MIROR-Compo, and MIROR-Body Gesture -, test them with children and teachers in several European countries, and validate them in different scenarios.

The Consortium worked on the implementation of quantitative and qualitative research supported by a "mixed method" approach. The experiments produced empirical data, which contributed to the implementation of the MIROR prototypes, support the theoretical framework of the project, and prepare the User and Teacher's Guide.

SONY and UNIGE (technological partners) developed and delivered several prototypes of the three MIROR applications. They worked in close loop with the psycho-pedagogical partners - who provided feedback on the outputs needed for the experiments, manipulation of the musical parameters involved (rhythm, dynamics, texture, etc.), and development of specific settings -, and with COMPEDIA conducted the market analysis and designed the exploitation plan having assessed the value and usability of the MIROR platform in the industry.

6. Main outcomes

- Systematic description of the theoretical framework of the reflexive interaction paradigm.
- Implementation of the use of the reflexive interaction paradigm in combination with embodied cognition.
- Empirical data supporting the effectiveness of the reflexive interaction paradigm and the MIROR platform in learning and the creative process in concrete educational/therapeutic scenarios.
- Three MIROR applications: MIROR-Impro, MIROR-Compo, and MIROR-Body Gesture.
- The Users' and Teachers' Guide: Part I introduces the pedagogical framework of the MIROR platform and the theoretical fundamentals of the reflexive interaction paradigm and reflexive pedagogy; Part II introduces several Practices for using the MIROR applications in different settings: educational (nursery, kindergarten, primary school), music schools, dance schools, therapeutic settings, teacher education.
- New and original techniques for research on child/machine interaction, based on the "mixed method" combining qualitative and quantitative data.
- Implementation of effective and interdisciplinary collaboration between soft and hard sciences.

7. Strengths and weaknesses

On the basis of the experiments it is possible to list the following strengths and weaknesses on the reflexive interaction paradigm, the MIROR applications and the MIROR methodology:

Strengths

- The reflexive technology and in particular the MIROR-Impro can enhance creative and emotional experiences, as described by the Flow theory.
- The reflexive interaction can enhance and develop children's musical dialogue and the ability to improvise with sounds.
- Reflexivity and embodiment can be combined to improve the effectiveness of music and dance technology-enhanced learning.
  The MIROR platform can enhance the co-regulation process in the therapeutic setting.
- The MIROR technology can be used in pedagogical scenarios with children and teachers.
- Implementation of several original research techniques, to combine quantitative and qualitative data in child/machine interaction studies.
- Implementation of a spiral collaboration between hard and soft sciences that shows that the development of technology in the context of psychology-pedagogy can be mutually fruitful.

Weaknesses

- The implementation of the reflexive interaction paradigm in terms of a constrained Markov model may have a number of intrinsic limitations such as the lack of knowledge about musical segmentation, phrasing, harmonic knowledge, meter, expression and so on; however the consortium is aware of these limitations and there is a possibility that they can be overcome in the future.
- Some analyses from the experiments have not been finalised and have not provided their final outcomes yet. However, the partners will continue to work on these topics and publish their results in the appropriate journals.
- It was not possible to realise complete experiments on the full application of MIROR-Body Gesture, however a validation has been planned for the coming months.
- No data were collected on the cross-cultural comparison, although several parallel studies have been carried out in different European countries.

8.Potential impact and use of the results

Impact is expected on education and learning, starting from music and dance education, but possibly extending to other fields, with the following aims:
- Assess the impact of the reflexive interaction paradigm on both music learning and general cognitive/learning processes, and promote an active approach to musical culture, based on a "music-making" concept, rather than "music-consuming";
-Promote the use of the MIROR platform in children and adults, enabling a wider access to music by experts as well as non-experts;
-Enhance the diffusion of music culture in EU society through experiments with the MIROR platform in several European countries.
In particular, the exploitation of the results will aim to and will be based on:
- The creation of the **MIROR Community** of users: researchers, children, educators, teachers, music therapists, parents, compulsory school, music schools, dance schools.
- The **open access to the MIROR applications**: in order to exploit the results and implement the MIROR community of users, SONY and UNIGE will give open access to the 3 MIROR applications.
- The publication of the **Users' and Teachers' Guide**, edited by UNIBO and with the contribution of the partners and the members of the Advisory and Liaison Board.

9. Future challenges

To continue the exploitation aspects, in particular to raise awareness and create a community for music education research around MIROR outcomes.
To design and implement the virtual environment of the MIROR Platform, i.e., the learning/teaching modules for using the three software applications, the users/teachers'/researchers' interfaces, the learning-objects for teachers, music therapists, children of different ages, music teachers, dance educators, tutors facilitators, teachers' training tools, etc.; the data bases to upload children's interesting compositions, improvisations and choreographies; the work in progress for researchers: to upload interesting practices, experiments and videos, documenting the work in progress research.

Relevant information and updates about the MIROR activity can be found at the project URL: www.mirorproject.eu.