Short project description
The MUSCLE network of Excellence (contract FP6-507752) is gathering 42 leading European research institutes around a joint research agenda aiming to achieve “Multimedia Understanding through Semantics, Computation and Learning”.

This pan-European initiative fosters close collaboration between research groups in multimedia data-mining and machine learning, in order to facilitate the broad and democratic access to information and knowledge for all European citizens.

The network has made significant progress and has now defined a new set of scientific challenges to be addressed over the next years in order to fully reach its objectives. Activities are driven by targeted work groups the MUSCLE e-teams, and the showcase projects. MUSCLE carried on several internal projects destined to deliver highly visual results able to promote the technology towards the research community, with a particular dissemination focus on the Industry. The objective of this showcasing activity is not only to bring integration a step further, but also to stimulate the uptake of MUSCLE technology by the industrial stakeholders in the field.

Summary of Activities
Initiated in March 2004, the project is now going through its final year of activity. During the year 2007, the project has successfully carried out the following achievements:

- The MUSCLE portal (http://www.muscle-noe.org) federating institutes around the network’s banner has been regularly updated thus providing further collaborative tools to support the integration of research partners and spreading the network’s achievement to a large public.

- The Internal Fellowship Programme launched the previous years to provide advanced training to future researchers has been carried on and dealt with the following topics in 2007:
  - Multimedia metadata: bridging the gap from low-level media specific features to high-level domain-specific semantic terms
  - Monte Carlo Learning (MCL) methods for event recognition in multimodal sources
o Feature subset selection and multi-sensor fusion techniques for affect recognition

- The Showcase projects launched in 2006 and aimed at featuring highly visual results able to promote the technology towards the research community with a particular focus on the Industry were continued. The underlying objective of this showcasing activity is not only to bring integration a step further, but also to stimulate the uptake of MUSCLE technology by the industrial stakeholders in the field. Details of these showcases can be found on the MUSCLE website at the URL: http://www.muscle-noe.org/content/blogcategory/19/64/

- In order to present the results of its showcase projects to Industry, MUSCLE participated to several professional exhibitions, namely:
  o CeBIT 2007 in Hannover Germany on 15-21 March 2007
  o Practitioner day at CIVR conference on 9-11 July 2007
  o International Broadcasting Conference (IBC) in Amsterdam, The Netherlands, on 7-11 September 2007
  o CeBIT Eurasia in Istanbul, Turkey on 3-11 October 2007

Hence, MUSCLE received a positive feedback from industrial contacts at these fairs. Other exhibitions are also planned in the year 2008.

- MUSCLE e-teams redefined in 2006 to address core scientific challenges in the field of Multimedia understanding have also been carried on. The E-teams currently focuses on:
  - Evaluation, Integration and Standards
  - Visual Content Indexing
  - Content Description for Audio, Speech and Text
  - Multimodal Processing and Interaction
  - Machine Learning and Computation Applied to Multimedia Description

**Important work areas**
The MUSCLE Network of Excellence has actively brought together 42 leading research teams in the field of multimedia analysis. The actual integration of these 42 teams around a joint scientific agenda has been successfully reinforced to address some of the research priorities described hereafter.

- **Moving from modelling to learning:** Harnessing the full potential of *machine learning* and *cross-modal interaction* for the (semi-)automatic generation of robust meta-data with high semantic value for multimedia documents. In particular, MUSCLE researchers will develop software tools and research strategies that enable users to move away from labor-intensive case-by-case modelling of individual applications, and allow them to take full advantage of generic adaptive and self-learning solutions that need minimal supervision.
• **Improving interoperability through understanding:** Improving interoperability and exchangeability of heterogeneous and distributed (meta)data by enabling data descriptions at high semantic levels (e.g. ontologies, XML schemata) and adding inference schemes that can reason about them at the appropriate levels. To this end MUSCLE researchers will contribute to relevant international standards and protocols.

• **Creation of expressive and adaptive interfaces:** In the same vein, improve the human-machine interface by exploring how machine learning can invigorate the creation of expressive, context-aware, and human-centered interfaces that will be able to effectively assist users in the exploration of complex and rich multimedia databases. With regard to these topics, MUSCLE research will contribute to viability studies and proof-of-principle demonstrators.

To stimulate cohesion, the Network set itself two **grand challenges.** These are ambitious research projects that involve the whole spectrum of expertise represented within the consortium. As such they also require the collaboration of a large number of groups and therefore act as focal points for the consortium:

- **Grand Challenge 1:** Natural high-level interaction with multimedia databases In this vision it is possible to query a multimedia database at a high semantic level. This is an extremely challenging problem and will involve a wide range of techniques: natural language processing, interfacing technology, learning and inferencing, merging of different modalities, federation of complex meta-data, appropriate representation and interfaces, etc.

- **Grand Challenge 2:** Detecting and interpreting humans and human behaviour in videos. Many important applications of multimedia data mining revolve around the detection and interpretation of human behaviour. Applications are legion: surveillance and intrusion detection, face recognition and registration of emotion or affect, automatic analysis of sports videos and movies, etc. Again, success will depend heavily on the integration and interpretation of various modalities such as vision, audio and speech.

To reach these two grand challenges, the network pursued its research efforts with the e-teams listed below:

- ET1: Integration of structural and semantic models for multimedia metadata management
- ET2: Visual saliency
- ET3: Person detection and recognition, tracking and analysis
- ET4: Shape modeling
- ET5: Choosing Features for CBIR and Automated image annotation
- ET6: Statistical analysis of visual processes
- ET7: Semantic from Audio
ET8: Audio-Visual Speech Analysis & Recognition
ET9: Multimodal Processing and Multimedia Understanding
ET10: Multimodal Interfaces
ET11: Dynamic Kernels
ET12: Active and Semi-Supervised Learning
ET13: Unsupervised image segmentation

In addition, the showcase projects aimed at producing prototypes for highly visual public showcasing and demonstrations covered the following subjects:

- Articulatory talking head, driven by automatic speech recognition
- Real-Time Audio-Visual, based on Automatic Speech Recognition Demonstrator
- Augmented assembly, using a multimodal interface
- Dynamic Texture, driven by Detection in Video
- Movie Summarization and Skimming Demonstrator
- Real Time Detector for unusual behaviour
- Content-Based Copy Detection for Videos and Still Images
- Automatic Character (in Audiovisual Document) Indexing
- Video retrieval, Image Retrieval and Video Copy Detection Evaluation Showcase
- Object recognition showcase
- Shaping 3-dimensional Environments

E-Teams and showcase projects address the underlying scientific bottlenecks that compose these challenges.

**User Involvement, Promotion and Awareness**

In addition to the dedicated MUSCLE web site (http://www.muscle-noe.org/) offering an open window into the network, several promotion and dissemination supports have been realized.

The poster and flyers produced the previous year have been distributed by the 42 partner institutes during the different conferences and workshops their teams attended. The partners acting as relays for the promotion of MUSCLE, the network has gained a large visibility.

Additional efforts were paid to promote the MUSCLE activities. In particular, the 42 partner institutes involved in MUSCLE have most of their researcher participating in international workshops and conferences where they present their latest scientific development and achievements in dedicated papers. All the papers produced and presented during these events refer to MUSCLE. The direct and indirect impact of this network on the scientific community is hard to measure, yet the number of publications and papers presented by the network is definitely increasing.
To raise the awareness in the corresponding scientific communities, the MUSCLE network will also organise its own conference, allowing all European actors in the field to participate, share their expertise and benefit form the MUSCLE critical mass gathered in the domain. This will be the opportunity to foster additional collaboration with other research teams in Europe to hopefully integrate additional teams around the MUSCLE research agenda.

Of course, MUSCLE also participates to the European Commission driven mass, in order to collaborate with related projects and initiatives already supported. The underlying idea is to support knowledge transfer and to disseminate excellence across all Europe to help build a homogeneous information society for all.
The MUSCLE Internal Fellowship Program is also a major element to raise public awareness. Candidates from all over the world are applying for the positions and additional calls will be released to ensure that all MUSCLE partners benefit from this initiative.

The ERCIM news magazine is also offering a reliable support to the dissemination effort. With over 10 000 copies distributed world wide, MUSCLE relies on this publication managed by ERCIM (MUSCLE coordinator) to publish news bulletins about on-going MUSCLE activities and to release scientific papers.

Furthermore MUSCLE participation to several professional exhibitions to promote the showcase projects destined to deliver highly visual results offers the opportunity to intensify the Network’s knowledge transfer and forge new research partnerships. A specific logo created for the launch of the showcases and it is being used and spread for MUSCLE communication.

Future work/event
MUSCLE final conference
As the MUSCLE project will be finishing at the end of February 2008, the Consortium will be organizing a final event, called the MUSCLE conference, which will be held on 11-12 February 2008 in Cannes, France.
This final dissemination event will give MUSCLE the opportunity to highlight and demonstrate the main results achieved by its community members in the field of Multimedia Understanding through Semantics, Computation and Machine Learning.
This conference will be open to the scientific community at large, to the European Commission and other EU funded projects.

Further Information
For further information, please consult: http://www.muscle-noe.org/