Short project description

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

Integrating the research efforts of 42 research institutes, this pan-European initiative fosters close collaboration between research groups in multimedia data-mining on the one hand and machine learning on the other, in order to facilitate the broad and democratic access to information and knowledge for all European citizens.

To effectively assist users in the exploration of complex and rich multimedia content, MUSCLE stimulates both the development of intelligent (semi) automatic tools, and the creation of expressive, context-aware, self-learning, and human-centered interfaces.

Summary of Activities

Initiated in March 2004, the project is now going through its eighth month of activity. During this period, the project has successfully carried out the following achievements:

- Establishment of the MUSCLE portal (http://www.muscle-noe.org/) federating institutes around the network’s banner. This portal provides both an overview of work carried by the different scientific clusters, and the collaborative tools to support the integration of research teams around a joint research agenda, while inviting external teams to participate to MUSCLE activities.

- Implementation of the Internal Fellowship Programme providing advanced training to future researchers: http://www.muscle-noe.org/ifp/objectives.html

- Preparation of the state-of-the-art for every scientific cluster (http://www.muscle-noe.org/workpackages.html)

- MUSCLE teams have already produced significant results ranking from software evaluations, to the definition of new tools analysing multimedia documents, including the adoption of a common frame for multimedia data description. These results lay a reliable ground for the next year of activity focusing on information retrieval and annotations in multimedia content.
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 initiated successfully to address some of the research described hereafter.

Yet in order to foster even further integration, the MUSCLE network is currently exploring a number of e-collaboration software packages in order to provide the tools and the general outlines of a dedicated Virtual Lab. Currently relying on the expanded capabilities of a collaborative tool (BSCW), the research teams spread across Europe now have a specific platform to exchange results and interact with one another to address the different technical bottlenecks facing the elaboration of advanced techniques and procedures to efficiently exploit the full potential of multimedia documents.

Yet, alternatives to the BSCW are being investigated to allow optimal cooperation and integration among the research teams. The solution which currently looks most promising is Macromedia's Flash Communication Server as it includes video and data broadcasts, shared whiteboards, virtual conference rooms and message boards. The scientific coordinator (CWI) has set up an internal pilot project to test the server's capabilities in a realistic setting. This tool if adopted will push further the synergies already in place around the following research priorities:

Benchmarking

The creation of first MUSCLE Benchmark Database is a real asset for the network. This work will be the basis for generating a massive object recognition/image indexing benchmark database. Currently, the database contains a special collection of more than 100,000 test images representing 1500 different object classes with known ground truth for test validation and comparison. This benchmark database is being hosted on a MUSCLE-dedicated server donated by partner TUWien-PRIP. Moreover, with a concern to harmonisation and integration, a questionnaire has been sent to all MUSCLE members to collect information on existing benchmarking data and software that can be used by the network teams.

The results of the questionnaire sent out to MUSCLE members have been analysed, and a list of data and software to be donated by the MUSCLE members has been placed on the web-page. The conditions of use of data and software document completed and placed on the web-page (Deliverable D3.2)

In the meantime, evaluations of the different softwares donated by MUSCLE partners for generating ground truth of images and videos have been performed and the best tools will be retained and adopted by the network.

Identifying and adopting the best tools for research and to support collaboration is the first step towards successful integration.
Single Modality Processing

This research cluster is an important cornerstone to the scientific agenda of the network as it aims to identify and validate the best multimedia analysis practices from the different existing perspectives. In particular, a state of the Art has been produced for all the following approaches:
- “Image and Video Processing for Multimedia Understanding”
- “Speech and Audio Processing”
- “Natural Language Processing”

Having defined the state of the art for these different multimedia analysis perspectives, MUSCLE will now be able to select the best techniques and investigate the compatibilities to support the emergence of additional interoperability among the different existing or emerging techniques.

Cross-Modal Integration for Performance Improving in MM

Relying on the Single Modality Processing contributions and on the Cross–modal state-of-the-art produced recently, the MUSCLE network is now is good position to implement efficient Cross-Modal Integration for Performance Improving in Multimedia;

To this end an interactive Web Site and collaboration platform have been developed. The official Web Site of MUSCLE now integrates a dedicated section to Cross-Modality and this section has been built using the TWiki collaboration platform which can be easily edited dynamically by all partners in a decentralized fashion. The section has been utilised successfully during the preparation of the Cross Modality State-of-the-Art deliverable.

Computation Intensive Methods

The MUSCLE partners have jointly collaborated to define a complete overview of the existing state-of-the-art. Their collaboration has also led to the compilation of links for software repository (Deliverable 7.2).

Machine Learning for MM Content

“A Review of Machine Learning Techniques for Processing Multimedia Content” was delivered in Sept 2004. This is a very comprehensive document on which 17 Muscle partners collaborated.

To ensure that all partners with expertise in the field will contribute and to ensure the emergence of synergies, a list of partner competencies associated with this activity has been compiled and it is included in the Deliverable.

Being a critical component of the MUSCLE underlying research agenda, a MUSCLE full-time post-doc fellowship associated with these activities has been accepted and this fellow will be recruited in the next quarter.
**Representation and Communication of Data and Meta-data**

The State of the Art on multimedia data and metadata standards has been further developed during this time period. The most relevant standards have been taken into account, considering both the context inside and outside the MUSCLE Network. Particular attention has been paid to MPEG family standards, also taking into consideration the main web technologies (XML, RDF,…) able to grant description of the multimedia objects and interoperability properties.

In order to have a wide view of the network context, a questionnaire has been developed and diffused among the organizations belonging to the NoE. The main work launched in this period consisted in the information collection process, realised using the aforementioned questionnaire.

This work represents a first step in a complex procedure of analysis that will allow us to define a possible strategy to follow in order to achieve an overview of (meta-)data standards and tools used to represent multimedia (MM) data content. In particular this report analyses the current data and metadata standards used by different groups in the Network of Excellence (NoE) and MM research communities for MM information exchange.

The main results have been the acquisition of the necessary know-how on the data and metadata standards for the MM data description and content representation. The acquired knowledge has been reported in the final document that presents a complete overview of the state of the art on standards and technologies. On this basis, also a strategy for achieving a MUSCLE MM description frame has been identified.

**HCI for Multimedia Retrieval**

Ultimately the tools and technologies developed by the MUSCLE teams will allow users to obtain information and knowledge more easily using context-aware, self-learning, and human-centered interfaces that will be able to effectively assist users in the exploration of complex and rich multimedia content.

To this end a state of the art was also performed to assess the different retrieval techniques and to lay a reliable ground for the development of advanced alternatives. Specifically, the system for web search, database storage of results, categorization of results and summarization of search results was implemented.

Work has now started on the design of the spoken dialogue interface for the information retrieval system.

**Integration and Grand Challenges**

Since the start of the project, the MUSCLE management team has provided a reliable framework to support the integration and collaboration of the teams. In particular, the MUSCLE Internal Fellowship Program was launched. A call to hire a post-doc was prepared and posted in various e-mail lists. The post-docs will spend 9 months two distinct MUSCLE partner institutes. There are several good applicants and fellows will be focusing on some of the grand scientific challenges in multimedia analysis.
A background estimation software for the “write-chat” software was developed. This software will be used by the MUSCLE partners to communicate with each other on-line by writing on a piece of paper.

In addition to the collaborative tools and the joint definition of the shared scientific agenda and priorities, several measures have been adopted to address some of the grand scientific challenges in the field. In particular, a state of the art report on automatic human detection in video, motion and behaviour analysis in multimedia data was prepared. Moreover, several innovative elements were developed among which:

- Methods for estimating motion tracking, differentiating robust structure from motion,
- A new method was developed which can derive relevant information about the significant body elements from video sequences showing walking people, without imposing severe or unusual constraints on the input images.
- The “Bilvideo” video database management system was improved to handle multiple requests over the Internet through a graphical query interface developed as a Java applet.
- An algorithm for contour based moving object classification is being implemented in video and an algorithm for fire and smoke detection in video was also developed.

**User Involvement, Promotion and Awareness**

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

Posters and flyers have been produced. These were first distributed during the EuroIndia International conference organised by the European Commission in New Delhi in March 2004. The poster and flyer have been distributed by the 42 partner institutes during the different conference and seminar their teams attended. The partner acting as relays for the promotion of MUSCLE, the network has gained a large visibility. Additional efforts are being paid to the development of other support such as project business card presenting briefly the main objectives of the network and pointing directly to the MUSCLE web site where external institutes are invited to contact the MUSCLE teams to cooperate on the joint programme of activities.

To raise the awareness in the corresponding scientific communities, the MUSCLE network will also organise a networking session during the IST 2004 conference organised in The Hague, Netherlands in November 2004. 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. MUSCLE has also agreed to participate in the IST-2004 Workshop Semantic Web – The Future of New Generation Intelligent Web Applications organized by Brian Macklin in The Hague (17 November 2004).

Given the early stage of development of MUSCLE, extensive participation to the IST 2005 event is already foreseen as this will be the opportunity to present the more concrete results besides the integration of the European research community in the field.
Moreover, the partner individually promote their participation to MUSCLE by organising specific event such as a PhD course on Partial Differential Equations and Level Set Methods in Image Processing.

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.

As part of its dissemination efforts, MUSCLE has also provided the EU sponsored Agentlink (www.agentlink.org) with activity information. The Agentlink initiative is designed to promote the visibility of major European project and network through a dedicated scientific magazine and through its web site.

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

Finally, the MUSCLE Trendsetter's Seminar is to be organised soon, towards the end of the first academic term to ensure a large participation and greater representation of the scientific community in the audience.

**Future Work**

In carrying out its joint programme of activities with 42 partner institutes, MUSCLE has already achieved the first part of its ambition: integrating disseminated research teams around a joint agenda. Yet, more integration efforts need to be done.

Indeed, series of scientific seminars and technical workshops will be organised to federate the teams even more around the same priorities. This will provided partner institutes with an overview of the different modalities processing, to be aware of related work among partners, to present new results and to reflect to possibilities for cross-modal integration.

The fellowship programme will also be intensified with additional call for proposals to be submitted by the partner institutes.

However, this now leads MUSCLE to the second phase of its programme, using this integration and critical mass of expertise to foster the emergence of synergies and to stimulate the development of advanced systems and techniques. In particular, the next year of activity will be essentially focusing on the development of advanced techniques for both information retrieval and annotations in multimedia content.

In order to pursue the coherent management of the MUSCLE activities, a coordination meeting will take place in Malaga on the 4 and 5 of November 2004. This will be the opportunity to perform an internal assessment of the tasks carried out and to decide the next moves of the network. In particular, focus will be on the preparation of the next
Joint Programme of Activities (JPA), planning the MUSCLE activities over the next 18 months period.

Further Information

For additional information, please consult:  http://www.muscle-noe.org/

Hereafter is the introduction to MUSCLE providing a brief overview of the network:
MUSCLE Objectives

- **Scientific:** Harnessing machine learning to automate semantic-based multimedia retrieval:
  - Creation of semantically rich metadata
  - Computer-assisted inference based on them

- **Integration:** Establish durable integration between key scientific and industrial players;

- **Dissemination:** Through benchmarking, dissemination and training stimulate uptake by end-users;

MUSCLE Scientific Objectives

- **Goal:**
  - Efficient data-mining of MMDB based on semantics and multimedia understanding;

- **Means:**
  - Improve effectiveness and robustness by combining different modalities (speech, text, audio, video);
  - Automate extraction of semantics through extensive use of machine learning and computational science;
  - Apply machine learning to improve human-computer interaction: moving from modelling to learning.
Scientific Workpackages (1)

- WP 5: Single Modality Processing:
  
  **Goal:** Improve performance of single modality processing (video, audio, text)

- WP 6: Cross-Modal Integration:
  
  **Goal:** Improve robustness of meta-data extraction by combining different and complementary modalities

- WP 7: Computation Intensive Methods:
  
  **Goal:** Harness the power of large scale statistical modelling and simulation for the exploration of multimedia databases

Scientific Workpackages (2)

- WP 8: Machine Learning for Multimedia Content:
  
  **Goal:** Apply and extend Statistical Learning techniques for the creation and interpretation of meta-data

- WP 9: Representation and Communication of Data:
  
  **Goal:** Extend standards for multimedia (meta-)data

- WP 10: HCI for Multimedia Retrieval:
  
  **Goal:** Facilitate natural interaction for MMDB

- WP 11: Integration Projects: Grand Challenges
Promoting Durable Integration

- Promoting mobility and facilitating Human Resources Management

- Network cohesion and integration stimulated by joint work towards two Integration Projects (“Grand Challenges”):
  - Natural high-level interaction with MM databases
  - Detecting humans and interpreting human behaviour in video

- Creation of a Virtual Lab: Through use of multimedia networking, facilitate easy and engaging access to people, ideas and data.
  - Exchange of software modules, multimedia preprint server, virtual meetings, tools for collaborative work, etc.

Dissemination

- Towards research community:
  - Creation and management of specialized databases (courseware, test-data, preprints, software tools)
  - Management of SIG related to MUSCLE topics
  - Training: Creation of 5 annual postdoc fellowships

- Towards commercial and industrial partners
  - Road maps, position papers and systematic benchmarking
  - Creation of an Application Forum to stimulate knowledge transfer between scientific and commercial parties
Contribution to EC Strategic Objectives and Expected Impact

- **Scientifically:**
  - Automatic and scaleable semantic annotation of multimedia content;
  - Generating robust semantic-rich metadata
  - Providing adaptive inference tools

- **Structurally:**
  - Network building and durable integration:
    - especially between different research communities (video, audio, speech, text)
  - Dissemination towards target industries and end-users:
    - Role as key-enabler for host of Semantic Web Technologies

Contact Information

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