Project proposals

Last year engineer student projects
Master thesis projects

International Research Center MICA
(Multimedia, Information, Communication & Applications)
IP de Hanoi – UMI2954/CNRS – INP Grenoble
Hanoi University of Technology, Vietnam

Academic year 2008-2009

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Project n° 1

Topic: Speech processing

Portable speech synthesis system for Vietnamese

Context:

Since its creation in 2002, the International Research Center MICA has conducted extensive research in the automatic processing of the Vietnamese language, with two main general directions:

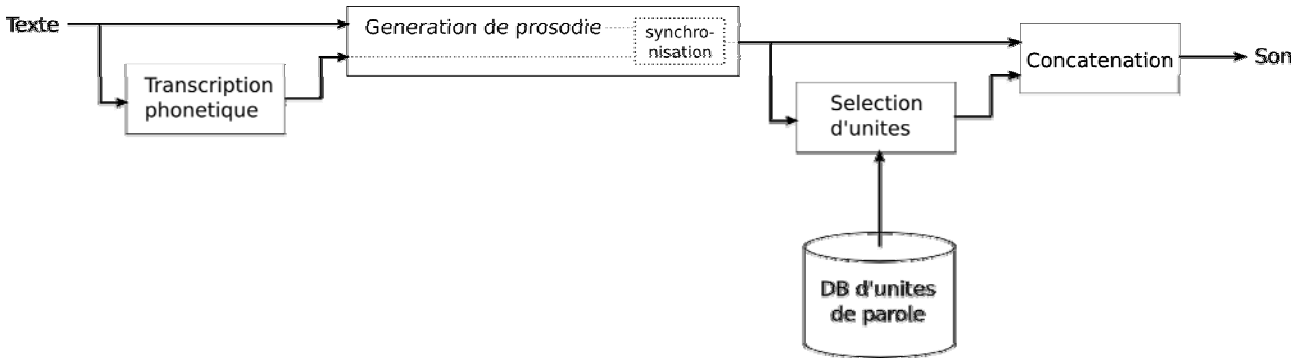
- offline automatic speech recognition (ASR) and analysis of multimedia documents or recordings for indexation of information retrieval,
- real-time ASR (Hoa Sen) and speech synthesis (Hoa Sung) for man-machine interaction or mediated man-man communication (automatic translation).

Hoa Sung project

For speech synthesis, a first important research work on the generation of Vietnamese speech by concatenation of "elementary" speech samples has brought very satisfactory results, letting us develop, fine-tune and adapt the chosen technique to Vietnamese. We now wish to consolidate this research by working on its concrete implantation:

- on PC, where it can be integrated, for example, in speech-to-speech automatic translation systems;
- on mobile devices, for example to propose a vocal rendering of text messages on cell phones;
- as an embedded system in order to give voice to a robotic equipment, in the framework of an industrial project developed at the lab.

Ideally, those three development tracks should be carried on in parallel, all three implementations sharing a same general structure, and as much code as makes sense.



A first version of several of the modules that constitute the system has already been developed:

- a phonetic transcription tool for Vietnamese, providing a standardized International Phonetic Alphabet representation of any Vietnamese sentence;
- a database system to store, manage and retrieve speech samples based on their phonetic and spectral properties;
- the central concatenative synthesis module, implementing the TD-PSOLA algorithm for the concatenation of speech samples.

Moreover, we already have some implementations, however imperfect, of the prosody (pitch and energy modulation, rhythm) generation module, and of the unit selection methods (the infrastructure of that search algorithm being integrated in the database).

Work program:

We wish to have several people working each on one of the various versions of the system while interacting on the global issues; we invite each candidate to let us know what platform s/he who prefer to work with. Individual candidates are of course welcome, and we will do our best to build a working team satisfying everyone's preferences.

First, the formats and data types used to exchange data between modules shall be defined – most are simple, but there is a challenge in defining a means of representation that maintain the exact synchronization between phonetic and prosodic commands.

The remaining modules of prosody generation and unit selection shall then be finalized, using existing work as a basis, and the compatibility of all modules shall be tested.

Finally, the actual system shall be "assembled" from its components to produce a full-fledged Vietnamese speech synthesis application.

The programming language used will of course depend on the chosen platform; however, we would like whenever possible to have development be done in Embedded C++, a subset of C++ defined for optimal portability, as other projects at MICA use that same language.

Working environment:

Students shall work as members of the TIM (Multimedia Information Processing) team at MICA Centre.

They shall be equipped for the duration of their work of a desktop PC with most common development tools and speech processing software.

They can benefit from help from the engineers composing the API (Industrial Prototypes and Applications) team of MICA

They may communicate with local work colleagues or partners in French or English.

Student profile:

- Engineer student (final 5th year) or Master student from computer sciences field or from signal processing field
- Vietnamese or French student (or from other countries)

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Mr. Tran Do Dat : do-dat.tran@mica.edu.vn

References:

1. TRAN Do Dat, *le titre*, Ph.D. thesis, Grenoble INP, 2007

1. Rüdiger Hoffmann, Oliver Jokisch, Guntram Strecha, Diane Hirschfeld "Advances in Speech Technology for Embedded Systems". In Proc. Conference on Assistive Technologies for Vision and Hearing Impairment CVHI, Granada, 2004.

2. Rüdiger Hoffmann, Oliver Jokisch, Diane Hirschfeld, Guntram Strecha, Hans Kruschke, Ulrich Kordon, "A multilingual TTS system with less than 1 megabyte footprint for ambedded applications". In Proc. Internation conference on Acoustics, Speech, and Signal Processing ICASSP, Hong Kong, 2003

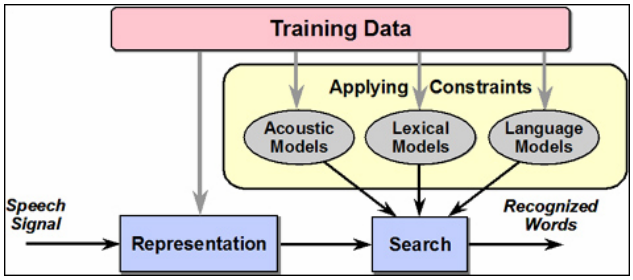
Project n° 2

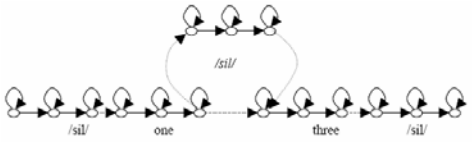
Topic: Speech processing

Speech recognition by acoustic gesture modeling

Context:

Automatic speech recognition (ASR) is typically split into two main processes: computing characteristics (usually spectral features) of the speech signal, and using a model of the phonetic and linguistic properties of the language. The characteristics of the signal are typically extracted by performing a spectral analysis every 10 to 20 ms, thus producing a series of characteristic vectors which are then run through a classification algorithm such as a neural network or hidden Markov model.





Most of the current limitations of ASR systems can actually be traced back to the very definition of the acoustic characteristics used for the classification. Indeed, for some 40 years, speech is considered as a sequence of quasi-stable signals (vowels) separated by transitions (consonants). It is also commonly accepted that vowels are acoustic "targets" that must be reached to make speech understandable.

ASR systems based on this imperfect modeling tend to be work only for one gender (we need to create specialized models for men and women), and fail completely at taking children voices into account.

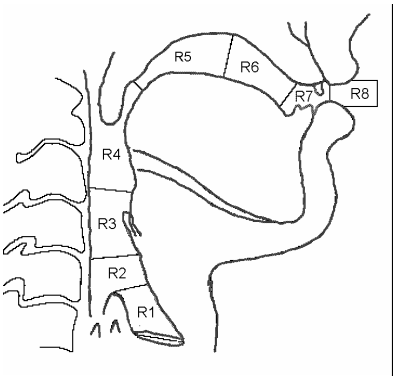
We propose with this project to try and develop a dynamic description of vowels in "acoustic gestures" to improve recognition accuracy.

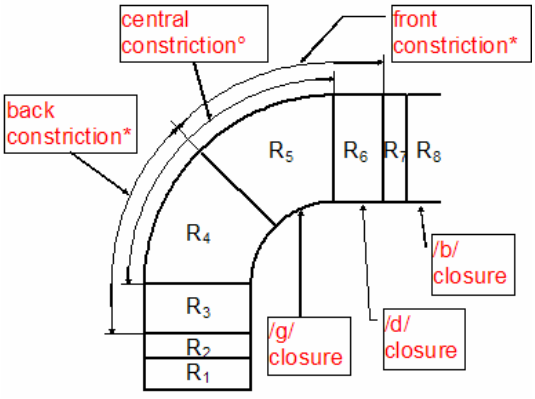
Work description:

Several studies conducted at MICA in cooperation with Pr. René Carré (DDL Lyon, CNRS senior researcher), have shown that the dynamics evolution of the speech signal over time may be modeled as a series of "acoustic gestures".

A first set of models for those acoustic gestures in the 3D space defined by the frequencies of the three first formants (resonances of the vocal tract that bear most vowel characteristics) has already been carried on, defining their general "shape", independently of their location.

We now wish to take that research further by working on the definition of a *discriminating* criterion, that is, for each identified gesture, the definition of a measure able to recognize it and no other. Such a measure may be directly used for an ASR task.





The first experiments shall be conducted considering the case of vowel to vowel transitions, using a reference corpus already recorded at MICA. That work may then be extended to the case of vowel-consonant-vowel transitions, where the consonant is a simple voiced one.

Prerequisites:

The candidate may make the choice of the programming language/environment to use (C, C++, Java, Matlab…) ; a good ability to program and produce prototypes fast is a must. Some basic knowledge of speech processing and digital signal processing would provide much help in the understanding of the approached phenomena.

Working environment:

Students shall work as members of the TIM (Multimedia Information Processing) team at MICA Centre.

They shall be equipped for the duration of their work of a desktop PC with most common development tools and speech processing software.

They may have to use specialized audio/video hardware (microphones, mixing table, acquisition cards, *etc.*) available at MICA.

They can benefit from help from the engineers composing the API (Industrial Prototypes and Applications) team of MICA

They may communicate with local work colleagues or partners in French or English.

Student profile:

- Engineer student (final 5th year) or Master student from computer sciences field or signal processing field
- Vietnamese or French student (or from other countries)

Contact and direction:

Mr. Eric Castelli : Eric.Castelli@mica.edu.vn,
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Project n° 3

Topic: Speech processing

Robust extraction of pseudo-formants for speech recognition

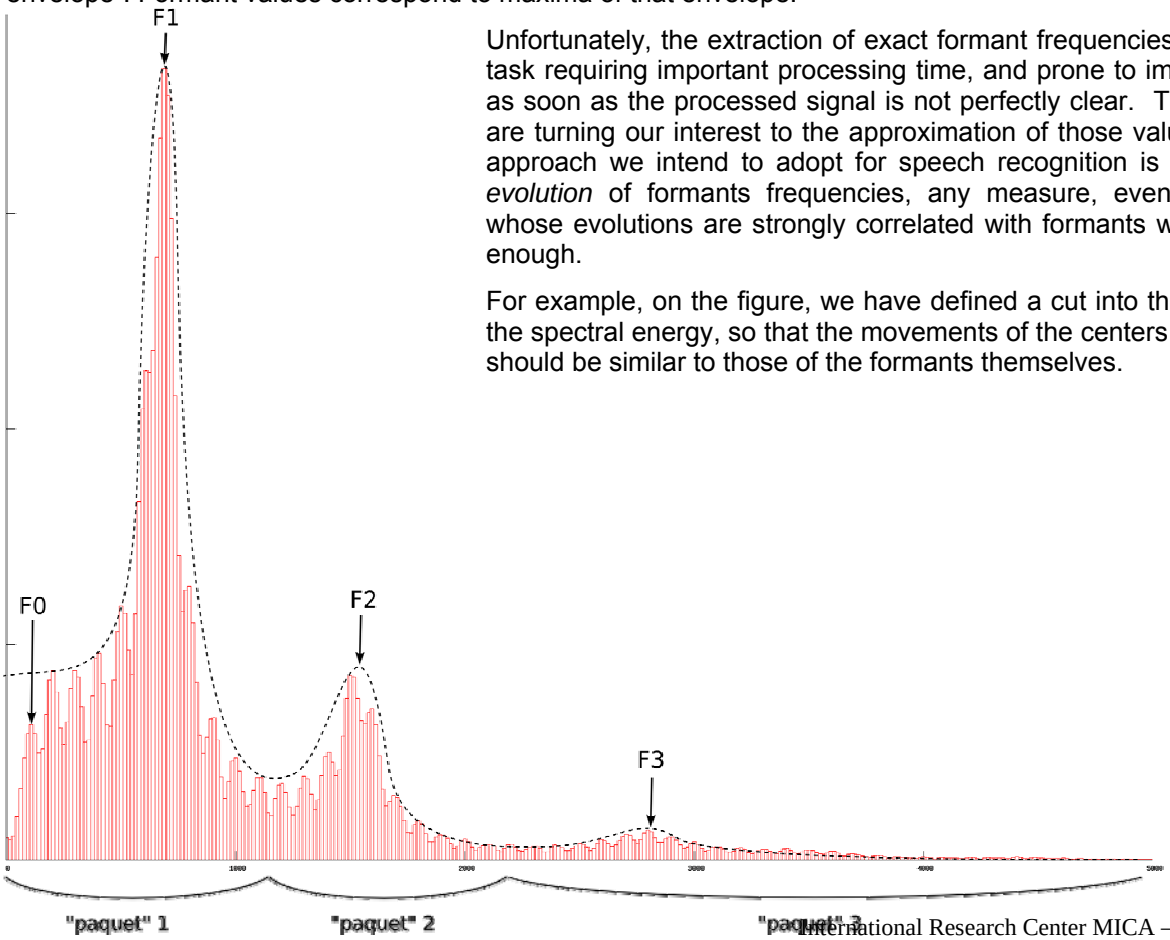
Context:

Since its creation in 2002, the International Research Center MICA has conducted extensive research in the automatic processing of the Vietnamese language, with two main general directions:

- offline automatic speech recognition (ASR) and analysis of multimedia documents or recordings for indexation of information retrieval,
- real-time ASR (Hoa Sen) and speech synthesis (Hoa Sung) for man-machine interaction or mediated man-man communication (automatic translation).

Hoa Sen project

In our research on ASR, we have been led to consider the temporal evolutions of formant values in the speech signal (see the project “Speech recognition by acoustic gesture modeling” for more details). Formants are the frequencies at which resonances appear in the human vocal tract, thus “shaping” the spectrum of the simple sound produced by the vocal tracts into the sound we recognize and interpret as some vowel. We usually consider in speech processing the first three formants, notes F1, F2 and F3. As an example, the figure below presents the Fourier transform of a small speech sample. One can see a series of small peaks corresponding to multiples of the fundamental frequency of the vocal cords (F0), whose heights follow a curve called “spectral envelope”. Formant values correspond to maxima of that envelope.



Unfortunately, the extraction of exact formant frequencies is a complex task requiring important processing time, and prone to important errors as soon as the processed signal is not perfectly clear. That is why we are turning our interest to the approximation of those values: since the approach we intend to adopt for speech recognition is based on the *evolution* of formants frequencies, any measure, even rudimentary, whose evolutions are strongly correlated with formants would be good enough.

For example, on the figure, we have defined a cut into three “packs” of the spectral energy, so that the movements of the centers of those zone should be similar to those of the formants themselves.

Work description:

The candidate shall propose several alternative “pseudo-formant” measures satisfying at least partially the described constraint of correlation with formant movements. He shall implement them and evaluate them:

- in terms of quality for speech representation (correlation with the actual formant values);
- in terms of computational robustness: numerical stability, possibility to obtain correct data from a noisy signal, etc.;
- in terms of “value for money”, that is, the practical interest of the technique taking into account its computational price.

Interesting results in that area may occasion a publication in specialized scientific outlets.

Prerequisites:

The candidate must be able to rapidly develop prototypes for the evaluation of his/her propositions; he may use Java, C/C++ or Matlab. Familiarity with at least one of those tools is a must. Basic knowledge in digital signal processing or signal processing would be useful to apprehend the issues at stake.

Working environment:

Students shall work as members of the TIM (Multimedia Information Processing) team at MICA Centre.

They shall be equipped for the duration of their work of a desktop PC with most common development tools and speech processing software.

They may have to use specialized audio/video hardware (microphones, mixing table, acquisition cards, *etc.*) available at MICA.

They can benefit from help from the engineers composing the API (Industrial Prototypes and Applications) team of MICA

They may communicate with local work colleagues or partners in French or English.

Student profile:

- Engineer student (final 5th year) or Master student from computer sciences field or signal processing field
- Vietnamese or French student (or from other countries)

Contact and direction:

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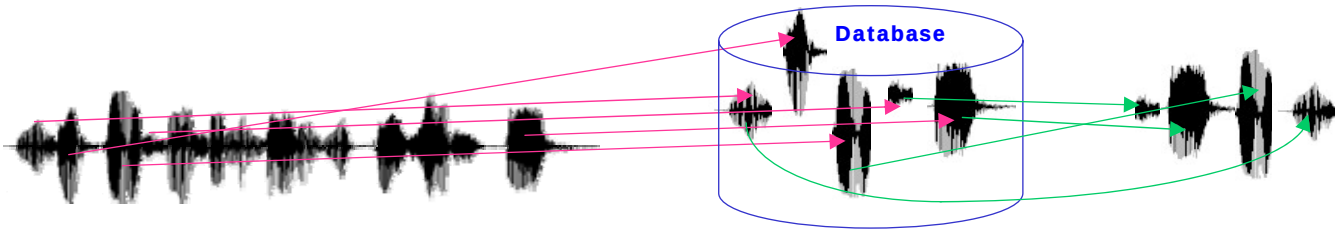
Project n° 4

Topic: Speech processing

Construction of a concatenative speech synthesis system using non-uniform acoustic units for Vietnamese

Context:

Traditional concatenative speech synthesis systems used to use one type of acoustic unit as concatenative unit such as phone, diphone, half-syllable, syllable. The synthesized speech with the big unit is normally smoother than ones with the small unit. However, the number of units is increased in respect to the size of unit; the system using bigger unit has to employ a bigger memory or bigger speech corpus. One solution to deal with this problem is using the non-uniform units; it means that speech synthesis systems can use either small units (phone, diphone…) or big units (syllable, words).



Speech synthesis concatenation principle

Work description:

Building a complete TTS using non-uniform acoustic units is an ambitious work. Thus this project aim at two principal works which are used for the low level of a TTS:

- Construction of a speech corpus and a database of concatenative units. The speech corpus will contain enough prosodic and spectral varieties for all synthetic units. Each unit in the database has to be represented by a descriptive contextual variation vector which will support for the selection of the best concatenative units in the phase of concatenation.
- Implemente an efficient algorithm for selecting the most appropriate synthetic units. The procedure of selection the best units sould be based on two cost functions (concatenation cost and target cost) which are widely used in the modern TTSs.

References:

1. Chu M., Peng H., Yang H., Chang E. “Selecting non-uniform units from a very large corpus for concatenative speech synthesizer”, Proc. ICASSP, pp.785–788, Salt Lake City, U.S.A., May 2001.

2. Colotte V., Beaufort R., « Synthèse vocale par sélection linguistiquement orientée d’unités non-uniformes : LiONS », in: Journée d’Etudes de la Parole - JEP’04, Fès, Maroc, April 2004.

Requirements:

The candidate may make the choice of the programming language/environment to use (C++, VisualC++, …) ; a good ability to program and produce prototypes fast is a must. Some basic knowledge of speech processing and digital signal processing would provide much help in the understanding of the approached phenomena.

Student profile:

- Engineer student (final 5th year) or Master student from computer sciences field or from signal processing field
- Vietnamese or French student (or from other countries)

Contacts and supervisors:

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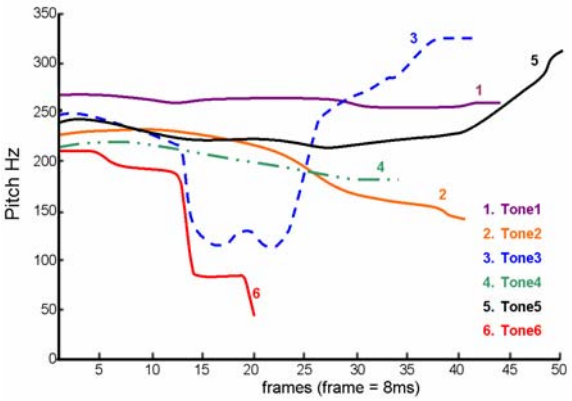
Project n° 5

Topic: Speech processing

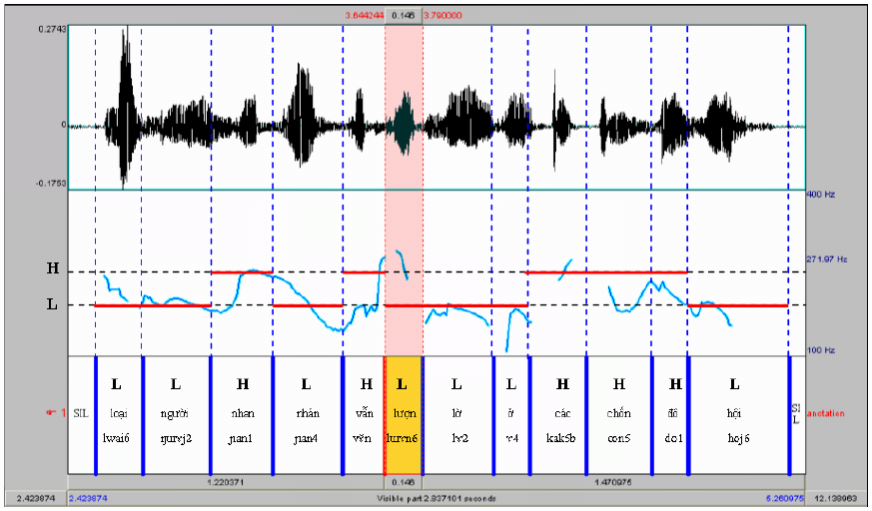
Modeling the F0 contour for 3 sentence types of Vietnamese language, application into generation of the F0 contour for Vietnamese speech synthesis.

Context:

In text-to-speech synthesis system, accurate generation of F0 contour is one crucial issue to obtain natural synthetic sounds. As is well known, for a tonal language, like Vietnamese, Chinese (Mandarin or Cantonese), fundamental frequency (F0) contours of utterances are always composed of tonal local features (tones and the coarticulation between adjacent tones) and the sentential intonation (corresponding to higher-level structures). This makes F0 movement of sentence in tonal languages more complicated than non-tonal languages such as English or French.



Some models for generating F0 contours of Vietnamese tone are presented in [Tran 2006] [Nguyen 2004]. The model of [Tran 2006] has just been for the contour of the tones in isolated mode. And the model of [Nguyen 2004], in which F0 contours of the 6 tones are generated by applying Fujisaki model, met a difficulty in modeling the variation of the contour of Tone 3 and Tone 6. In addition, both of the two models do not take into account the influence of the tonal coarticulation effect between adjacent tones while modeling F0 contours. Thus, it is necessary to have adaptive solutions for this problem.



Work description:

This project contains the following main works:

Analyze the variations of Vietnamese tones in the continuous speech.

Study and analyze the tonal coarticulation phenomena of Vietnamese language.

Based on the analyzed results on variations of Vietnamese tones and on the tonal coarticualtion, selecting or proposing an efficient model for modeling and generating F0 contour for Vietnamese language.

References:

1. Tran D.D. Castelli E., Serignat J.F., Trinh V.L. & Le X.H., “Linear F0 Contour Model for Vietnamese Tones and Vietnamese Syllable Synthesis with TD-PSOLA”, Proc. TAL2006, La Rochelle, April 2006

2. Nguyen, D.T., Mixdorff, H., et al., "Fujisaki Model based F0 contours in Vietnamese TTS”, ICSLP2004, Korea, pp. 1429-1432, 2004.

3. Boite R, Bourlard H., Dutoit T., Hancq J., et Leich H., « Traitement de la parole » Collection électricité, Presses Polytechnique et Universitaires Romandes, 2000.

4. Dutoit T., “An introduction to text-to-speech Synthesis”, Kluwer Academic Publics, 326 pp. 1997.

5. Keller E., (2002), “Toward greater naturalness: Future directions of Research in Speech Synthesis” in Keller E., Bailly G., Monaghan A., Terken J., et Huckvale M. (Eds.) Improvement in Speech synthesis, John Wiley and Sons, 2002.

6. Huang X., Acero A., and Hon H.W., “Spoken Language Processing - A Guide to Theory, Algorithm, and System Development”, Prentice Hall, ISBN: 0-13-022616-5, 2001.

Requirements:

The candidate may make the choice of the programming language/environment to use (C++, VisualC++, …) ; a good ability to program and produce prototypes fast is a must. Some basic knowledge of speech processing and digital signal processing would provide much help in the understanding of the approached phenomena.

Student profile:

- Engineer student (final 5th year) or Master student from computer sciences field or from signal processing field
- Vietnamese or French student (or from other countries)

Contacts and supervisors:

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Project n° 6
Topic: Speech processing

Building a speech database for automatic control systems using human machine interaction by voice in Vietnamese.

Context:

Nowadays modern control systems are more and more intelligent, the interactions between users and machines is more friendly and flexible. Systems controlled by voice has been a dream for a long time, and thanks for the development of speech signal processing technology this dream is now becoming reality. The first task for developing such system is to collect all voice interaction commands which will be used by the system. Thus this project aims at building a large speech corpus which contains all words, phrases and sentences used in control systems.

Work description:

- Study the operation tasks of control systems in industrial applications and embedded applications.
- Based on the tasks of automatic control systems and the requirements of human machine interfaces, the student will propose a text corpus. This text corpus contains all words, parts of speech, phrases and sentences which are usually used in human machine interactions.
- Record the text corpus with 50 speakers. The recording phase will be held in the studio of MICA center or in the office environment.
- Annotate automatically the speech corpus using an automatic speech recognition system and then correct manually.

References:

1. Tran Do Dat, “Building a large Vietnamese Speech Database”, Master thesis on Signal processing and Communication of Hanoi University of Technology, September 2003.
2. Lou Boves, Els del Os. “DEL 3.1.1.1 Report on working standards for speech data bases directed towards short and medium term applications”, October 15, 1995.
3. Dorota Iskra, Beate Grosskopf, Krzysztof Marasek, Henk van den Heuvel, Frank Diehl, Andreas Kiessling. “SPEECON – Speech Databases for Consumer Devices: Database Specification and Validation”.

Requirements:

Good organization skills, a good ability to program and produce prototypes fast are a must. Some basic knowledge of speech processing and digital signal processing would provide much help in the understanding of the approached phenomena.

Student profile:

- Engineer student (final 5th year) or Master student from computer sciences field or from signal processing field

- Vietnamese or French student (or from other countries)

Contacts and supervisors:

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Project n° 7

Topic: Speech processing

Integrating keyword recognition algorithm into DSP

Context:

As a sub-branch of the national project VLSP on Vietnamese language processing, this work's objectives consist in recognize a set of 10 speech keywords in Vietnamese language to control/command some kinds of device/machine. Some instances are "Bật máy" to turn on a computer, "Tắt máy" to turn off it, etc. This application will be used as a vocal human–machine interface in order to simplify the interaction between peoples and machines, in severe environments.

Tasks to do:

1. Study on keyword recognition

Student will study on speech recognition, and specifically on keyword recognition. This consists of studies on audio feature set (fundamental frequency, Mel frequency cepstral coefficients, for example) and on recognition model (Hidden Markov model, hybrid models for instance). Student will use the specific Hoa Sen toolbox, design in MICA Center for all kind of automatic speech recognition applications. However, students will specifically take care of the performances of the system: size of the code source, the speed of the algorithms, size of the memory, transfer through buffers, etc. This optimization is a fundamental point in order to realize an efficient product, able to perform recognition in real time.

2. Integrate a keyword recognition algorithm into a DSP (Texas Instruments)

DSP (Digital Signal Processor) is a specific processor dedicated to signal processing. It supports the algorithms such as Fast Fourier Transform. For this reason, DSP is particularly appropriate to a keyword recognition algorithm.

The selected algorithm will be written in C programming language in order to implement it in the DSP, but students will take care of optimization of performances.

3. Set up an acquisition subfunction

The keyword recognition is expected to function with real audio signal. Hence an audio signal acquisition is inevitable. This operation can be carried out through a codec (coder/decoder) module. This module is already integrated in the DSP evaluation board.

4. Concatenate the acquisition and the keyword recognition.

Working conditions:

- Student will work in SIA team (Systèmes d'Instrumentation Avancée – Advanced Instrumentation Systems) of the MICA Center

- He will use, during all the duration of the internship, a PC computer, a DSP evaluation card and associated software.

- He will have benefit of the help coming from engineers of the API team, in MICA Center.

- Student would use Vietnamese, English or French to communicate with Centre MICA staff, and with international partners of MICA Center

Student profile:

- Engineer student (final 5th year) or Master student from computer sciences field or from signal processing field
- Vietnamese or French student (or from other countries)

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Project n° 8

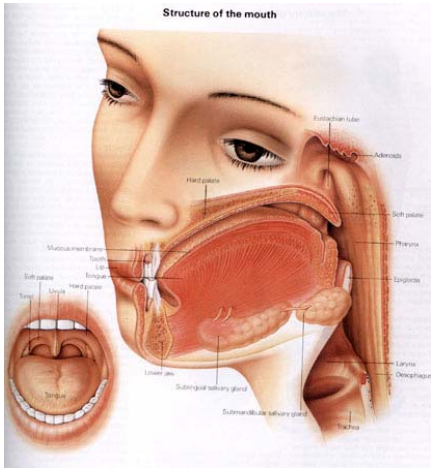
Topic: Speech processing

Anthropomorphic synthesis model for the generation of Vietnamese consonants

Context:

There exist two main families of techniques to produce artificial speech sounds by computer:

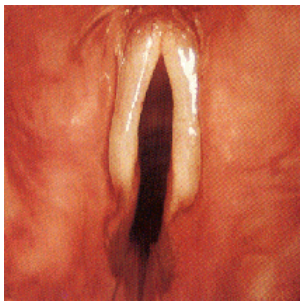
- Either the synthesizer produces new sound by warping and concatenating existing speech sound samples from real speakers (cut into elementary syllables, phonemes or diphones) and “smoothing” the signal using various signal processing techniques to have the result sound as natural as possible. This approach is often considered as “pretend-” synthesis, and is the one most currently used today because it offers a good trade-off between processing power and quality. However, it is also widely considered that that approach has reached its limits in today's systems.
- Either the synthesizer attempts to simulate, thanks to a digital physical model, the speech production mechanisms present in the human body – vocal cords and vocal tract. This second approach is called “anthropomorphic synthesis”, and can be seen as “mimic” synthesis. It allows producing speech of an excellent quality and seems therefore to be a very promising track for the future, since today's computer start to be able to cope with the large amount of calculations needed to run the model. One of its greatest advantages is that any voice can be produced without having to record a new speaker, and it does not put any restriction on the synthesized language.

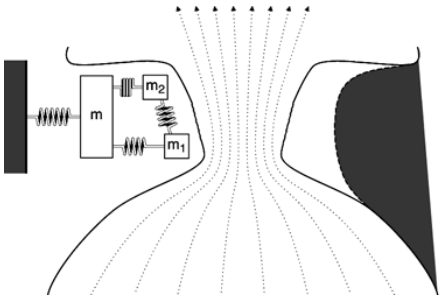


This project is concerned with the second method, and addresses one of its main difficulties: finding the right values of the parameters of the model to produce a specific sound.

Work description:

The candidate shall first make himself familiar the theoretic background involved in this study, and learn to use the existing anthropomorphic synthesis software in use at MICA. He shall then study the DRM (distinctive region model) developed by Rene Carré to infer model parameters from acoustic properties.





From that knowledge, he shall try to mimic using the model the production of the consonants of the Vietnamese language, in order to be able to synthesize some simple vowel/consonant/vowel transitions, and some simple words.

Pre-requisites:

Some knowledge of C/C++ is required to understand the operation of the existing synthesis and training code, and possibly “customize” it. Some knowledge of speech processing would be a plus to understand the principles of the work

Working environment:

Students shall work as members of the TIM (Multimedia Information Processing) team at MICA Centre.

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They may have to use specialized audio/video hardware (microphones, mixing table, acquisition cards, *etc.*) available at MICA.

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- Vietnamese or French student (or from other countries)

Contact and direction:

M. Eric Castelli : Eric.Castelli@mica.edu.vn,
M. Nguyen Viet Son : Viet-Son.Nguyen@mica.edu.vn

Cooperation:

This project is conducted in the framework of a cooperation with the DDL lab (Lyon, France) and TSI/Paris ENST (France).

Project n° 9

Topic: Speech Processing

TALN: Validation of a model of the linguistic comprehensiveness for the generation of speech in Vietnamese

Context

The objective of this work is to perform MICA speech synthesis. It aims at yielding a greatest variability than syntactical can make it up to now, by adding to the intonative curve calculated in a traditional way, a melodic prominence in the lexical items. This melodic prominence is calculated according to a new theorization, that of the "Comprehensiveness". This kind of analysis takes place in a process of speech generation within the frame of the synthesis of Vietnamese, and exactly at the output of an automatic prosodic analysis and morphological labeling system.

In fact this grammar is simple because aiming at processing more easily the melodic variability, it first transposes and reduces the syntactic and the morphosyntactic variabilities to only two semantic values, which have the property at the same moment to be qualitative and quantitative. The result of the analysis is within the framework of a sentence, to estimate the respective weight of the lexical items: the biggest the weight and the biggest the melodic prominence. The method is then to apply these melodic breaks and the temporal contrasts to the intonative line stemming from a traditional syntactic and\or rhythmic analysis. The interest of the work is to automate the procedure by resolving problems posed by this new linguistic theorization, and to contribute to a great improvement of the monotony of the synthesized voices. This subject can continue up to PHD.

To note: as the analysis of the Comprehensiveness is made from a morphosyntactic analysis, the method is generalizable in any language, tonal or not, only the mode of realization of the accent or of the tone has to be adapted to the particular language.

Work to be done

Having acquainted with the linguistic model "Comprehensiveness", with its manual application to the various texts, having applied the procedure of segmentation in prosodic groups, and tagged the morphosyntactic units, it is then a question:

1- of converting the morphosyntactic units in macroclasses (reduction of the morphosyntactic complexity),
2- that is to say, of converting the relevant macroclasses in units of comprehensiveness (that is « C » for « comprehensiveness », or « U » for « uncomprehensiveness »), in function of the context (embedding groups / embedded groups), in order to definitively attribute the labels C and U,
3- according to the segmentation in prosodic groups, to allocate to each of them, the right level of structuration depth in the tree, function of the rules of the comprehensiveness syntax (generation 0),
4- then in an iterative way for each of the groups stemming from the generation 0, a less deep level to determine the boundaries of generation 1, and so on until the last prosodic group,
5- then within the last group of generation (x), to attribute in the same way a level to the lexical items,
6- afterwards, to attribute the orientations of slopes (↗ or↘) to the lexical items and their gradient according to the levels ascribed at the previous stage (step 5),
7- then to insert these data (slopes and gradients) in the intonative curve,
8- and finally, to make a perceptive evaluation of the sentences intonation generated in this way.

References

- G. Caelen-Haumont, un modèle de la complétude pour la génération de parole.

Pre-required knowledge

Good knowledge of the tools of programmation, of the signal processing. Language C/C ++. Have performed a good training course in speech processing (for example that of Mr. Trinh Van Loan).

Student profile:

- Engineer student (final 5th year) or Master student from computer sciences field
- Vietnamese or French student (or from other countries)

Work conditions

- The student will work within the team TIM (multimedia data processing) of the Center MICA,
- He/she will have at his/her disposal during all the duration of their work, a computer PC Pentium, with the complete software environment Praat,
- He/she will also benefit from the help of the engineers of the team API (Applications and Industrial Prototypes) of the Center MICA.
- For the work, the student can use English or French for the discussions with the various international partners of the Center MICA involved in the project.

Contacts and direction

Geneviève Caelen-Haumont, genevieve.caelen@mica.edu.vn
Mathias Rossignol, mathias.rossignol@mica.edu.vn

Project n° 10

Topic: Speech processing – prosody, linguistics

Analysis of the traditional trade melodies of the street

Context:

The aim of this work is to record and study the melodies that are sung by the professionals in the street in order to inform customers of the nature of their trade. These professionals are typical in Vietnam, and especially in Hanoi, they may be pedestrians or ride a bike. For instance they may propose to sell a great amount of things, edible foods, house objects, fashion items …, to take off broken-down or out of service machines or utensils, or to repair anything in the house. Each one sings a specific melody over some notes, which allows them to be identified.

Work to be done:

The melodies recordings will be automatically processed in order to get wave files, and then these files will be analyzed through the program for speech analysis « Praat », completed by specific software (MELISM), as follows:

- recording of the corporative melodies in the street in good acoustical conditions, in the different trade fields,
- segmentation of the melody in words through Praat,
- automatic analysis of the segmented words melody,
- search of the main features of the melody (fundamental frequency, time, energy) and melodic patterns,
- classification of these melodies by type (melody/shout, melody motives, length, kinds of trades, difference male / female, difference pedestrian / on bike, kinds of message …),
- grounds of an historical and ethnological research in the trade families (are these melodies old, how many generations, can they be borrowed from another family, or another ethnic group ? …).

References:

- CAELEN-HAUMONT, G.; AURAN, C. The phonology of Melodic prominence: the structure of melisms. Actes, Speech Prosody 2004 (2004 mars 23-26 : Nara, Japon). 2004, p. 143-146.
- CAELEN-HAUMONT, G., Emotion, emotions and prosodic structure : an analysis of the melisms patterns and statistical results in the spontaneous discourse of 4 female speakers from four generations, chapitre d'ouvrage, in Sylvie Hancil éd., The Role of Prosody in the Expression of Emotions in English and in French, Peter Lang, (à paraître).
- CAELEN-HAUMONT, G., Melodic prominences structures: exploring to what extent the speaker variability is spreading, Proceedings of the International Acoustical Society of America (ASA) Congress, Paris, 3513-3518.
- CAELEN-HAUMONT, G., Structuring F0 prominences (melisms): an analysis of the statistical concordances between four French speakers, Speech Prosody, in ed. Barbosa, Madureira et Reis Proceedings of Speech Prosody Conference, Campinas, Brésil, 317-320.

Pre-required knowledge:

Be a linguist and be interested in the domain of speech. Have a good knowledge of the phonetics of the Vietnamese. Speak French or English.

Student profile:

- Engineer student (final 5th year) or Master student from linguistic field
- Vietnamese or French student (or from other countries)

Work conditions:

- The student will work within the team TIM (Multimedia Data processing) of the Center MICA.
- He/she will have at his/her disposal a computer PC Pentium, with a complete software environment of Praat and MELISM.

Contact and direction:

Geneviève Caelen-Haumont, genevieve.caelen@mica.edu.vn

Project n° 11
Topic: Audio processing

Integrating audio classification algorithms into DSP

Context:

The audio classification algorithms consist of a sound classifier, a speech/non-speech discriminator and a speech/scream-groan. They are expected to be embedded in an audio analysis system. This one is intended to be installed in a patient's room in order to detect situations of distress, and this detection is based on audio analysis. It is within a framework of a telemedical project. Those three algorithms have been already implemented in PC (with a multi channel data acquisition card) and showed good performance.

Tasks to do:

1. Study on audio classification and DSP

Student will study on pattern classification and specifically on audio classification. These topics deal with problems such as feature set, reduction of dimension of feature set, and classification model. Knowledge about test procedures (10-fold cross validation, leave-one-out, for instance) will be also needed.

DSP (Digital Signal Processor) is a specific processor dedicated to signal processing. It supports the algorithms such as Fast Fourier Transform. For this reason, DSP is particularly appropriate to an audio classifier.

2. Install the three algorithms in a DSP (Texas Instruments)

The three audio classification algorithms are built in C programming language and installed in PC. Student will have to transfer those codes into the DSP. This is not a big problem, because programs in DSP of Texas Instruments can be also edited in C.

3. Test digital filters, select the most appropriate one, and install it in DSP.

The three algorithms already showed good performance in case of the ideal condition: the captured audio signals are not affected by noise. In real condition, the ratio of good classfication is decreased. Therefore it is necessary to apply a digital filter algorithm to acquired signals. Student will be to select the most appropriate filters between different types. An echo cancellation filter will be probably fitted.

This filter module is to be a pre-processing step of the three audio classification algorithms, and will be installed in DSP.

Working conditions:

- Student will work in SIA team (Systèmes d'Instrumentation Avancée – Advanced Instrumentation Systems) of the MICA Center

- He will use, during all the duration of the internship, a PC computer, a DSP evaluation card and associated software.

- He will have benefit of the help coming from engineers of the API team, in MICA Center.

- Student would use Vietnamese, English or French to communicate with Centre MICA staff, and with international partners of MICA Center

Student profile:

- Engineer student (final 5th year) or Master student from computer sciences field or signal processing field
- Vietnamese or French student (or from other countries)

Contacts:

Nguyen Cong Phuong, cong-phuong.nguyen@mica.edu.vn
Nguyen Thi Lan Huong, lan-huong.nguyen@mica.edu.vn

Project n° 12

Topic: Image and video processing

Object tracking based on affine covariant regions

Context:

The object tracking is the process of locating the moving objects in the scene by using video sequences acquired by the cameras. The results of the object tracking can be used for further video analysis such as human behavior analysis, event recognition. The approaches proposed for the object tracking can be divided into : blob tracking, kerner-based tracking, contour tracking and visual feature tracking approaches. The object tracking is an interesting but difficult problem in computer vision. People are often occluded by others people or by others objects in the scene. The first results of the object tracking, but far from perfect, have been obtained. However, it is still a challenge.

The affine covariant regions aims at identifying regions in the image that are covariant to the affine transformation such as rotation, translation. They can therefore enable to find the corresponding objects in the images under affine transformation. The obtained results of object matching [Mikolajczyk, 2005] by using the affine covariant regions show that the affine covariant regions are robust even in difficult cases : objects are partially occluded or clutter. This precious property can be used to tackle the issues of the object tracking. The work of Trichet et al. [Trichet, 2008] is one of the preliminary works dedicated to the object tracking using the affine covariant regions. The obtained results are promising. However, it needs more works in the choice of affine covariant region types, the strategy for regions matching, regions labeling and regions tracking. Those works are the objective of this subject.

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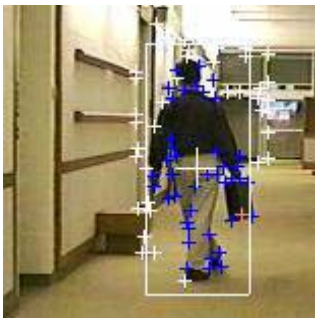


Fig1. The detected keypoints belonging to human and non human [Trichet, 2008]

Work:

Theory:

Study the current aspects for the object tracking problem.

Study the affine covariant regions.

Propose new approach for object tracking using the affine covariant regions.

Practice:

Implement the proposed approach in C++ and evaluate the proposed approach in video sequences.

Requirements :

This subject is dedicated to Vietnamese students as well as foreigner students at Master degree of Signal and Image processing option. The students who have a fairly good knowledge about image processing and C++ programming are privileged.

Student profile:

- Engineer student (final 5th year) or Master student from computer sciences field
- Vietnamese or French student (or from other countries)

Supervisors:

This internship will be taken place in MICA, under the supervision of Eric Castelli, Vice- Director of MICA and Le Thi Lan, PhD student in MICA, Vietnam and PULSAR (ORION), INRIA, France.

References

- Mikolajczyk, K., Tuytelaars, T., Schmid, C., Zisserman, A., Matas, J., Schaffalitzky, F., Kadir, T. and Gool, L.V., A comparison of affine region detectors. In IJCV 65(1/2),43-72, 2005.
- Mikolajczyk, K. and Schmid, C., A performance evaluation of local descriptors. In PAMI 27(10),1615-1630, 2005.
- Sivic , J. & Zisserman, A., Video Google: Efficient Visual Search of Videos, Toward Category-Level Object Recognition, LNCS 4170, 127-144, 2006.
- Arasanathan Anjulan and Nishan Canagarajah. Object based video retrieval with local region tracking, Image Communication, 2007, 22 (7-8),607-621.
- Donoser, M. and Bischof, H. Efficient Maximally Stable Extremal Region (MSER) Tracking, IEEE Computer Society Conference on Computer Vision and Pattern Recognition, 2006,1, 553 – 560.
- Rémi Trichet, Bernard Mérialdo, A Tracking Repositioning Algorithm using Keypoint Labeling, Conference on Content-Based Multimedia Indexing 2008, London, UK.

Project n° 13

Topic: Image and video processing

Using Histograms of Oriented Gradients (HOG) for human detection in video sequences

Context

Object detection or human detection in particular is the primordial step in video analysis module. The reliable results coming from the human detection step play an important role in human tracking, event recognition and human retrieval. However, humans have been proven to be a much more difficult object to detect because of the wide variability in appearance due to clothing, articulation and illumination conditions that are common in outdoor scenes.

In the context of **PERSPOS** (**PERS**onne **POS**itioning system) project, the human detection using information coming from the cameras can be combined with the others sources of information such as RFID to identify the human location.

The histograms of oriented gradients (HOG) have been firstly proposed by Dalal et al. [Dalal, 2005], [Dalal, 2006] and widely used for the human detection. However, the Hog is costly to compute. Integrating Hog with other techniques such as the integral image [Viola, 2004] allows reducing the computation time.

This subject aims at implementing a module for human detection by using Hog and machine learning.

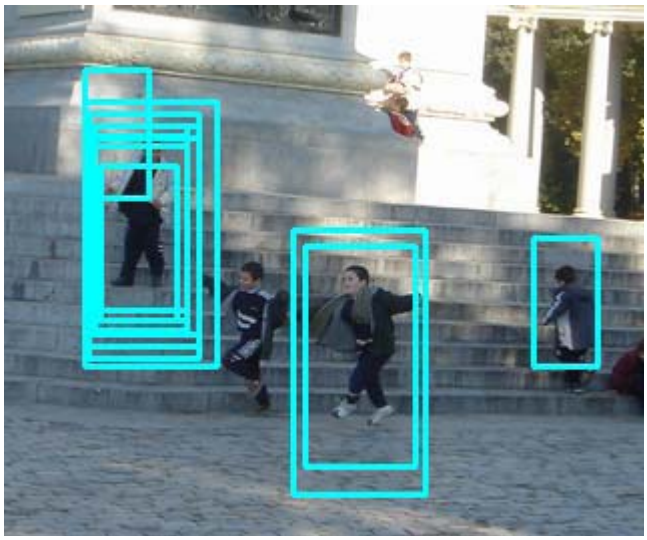


Fig. 1: Result of the human detection [Zhu06]

Work:

Theory:

Study the HoG extraction algorithm, integral image and machine learning (SVM in particular).

Practice:

Implement the HoG algorithm by using the integral image technique in order to extract HOG information from an image. A module of human detection must be done based on the learning technique and extracted HOG.

Requirements:

The project shall be developed in C++, and knowledge of that language is required. Basic notions of image processing and amchine learning would be a plus.

Student profile:

- Engineer student (final 5th year) or Master student from computer sciences field
- Vietnamese or French student (or from other countries)

Supervisors:

This internship will be taken place in MICA, under the supervision of Eric Castelli, Vice- Director of MICA, and Le Thi Lan, Phd student in MICA, Vietnam and PULSAR (ORION), INRIA, France.

References:

- N. Dalal and B.Triggs Histograms of oriented gradients for human detection. IEEE Conference on Computer Vision and Pattern Recognition, 1:886-893, 2005.
- N.Dalal, B. Triggs, and C. Schmid. Human Detection Using Oriented Histograms of Flow and Appearance. ECCV, 2006.
- Qiang Zhu, Shai Avidan, Mei-chen Yeh, Kwang-Ting Cheng, Fast human detection using a cascade of Histograms of Oriented Gradients . IEEE Computer Vision and Pattern Recognition 2006 (CVPR 2006).
- Paul Viola and Michael J. Jones, Robust Real-Time Face Detection, Int. J. Comput. Vision, 57, 2, 2004, 137—154.

Project n° 14

Topic: Image and video processing

Slide text detection and markup in a video sequence

Context:

The MARVEL project (Multimodal Analysis of Recorded Video for E-Learning) aims at developing automatic and semi-automatic tools for the production of multimedia documents for e-learning. The idea is to assist a teacher in transforming a recording of a live class (one or two microphones and cameras) into a structured e-learning document. The work proposed here takes place in one of the first stages of the analysis of the recording: the extraction of the various constituent parts of the class – the teacher himself, his speech, his movements, the slides, the text from the slides, the blackboard, *etc*. The MARVEL project as a whole gathers all those components in the framework of a multimodal analysis, combining competences in image processing, computer vision, speech processing, data indexing and video editing.

Work description:

The work involved in this project bears on the detection and recognition of slide text in course video recordings. The first task is to find what zones of the slide contain text, the second to accurately identify its outline, and finally to recognize using existing OCR (Optical Character Recognition) techniques, which the candidate should adapt to this particular application.

A second phase of the work consists in marking up important keywords contained in the slides, in order to efficiently index their contents. For that, many parameters such as the position, size, color, weight, font, *etc*. of the text can give indication of relative importance of a word in its context. Some form of hierarchical analysis of the title-subtitle-subsubtitle structure of the slide may also be performed.

The prerequisites for this project are a good grasp of C/C++ programming, and at least basic knowledge of image processing techniques.

References:

T. Martin, A. Boucher & J.-M. Ogier. Multimodal Analysis of Recorded Video for E-Learning. In *MULTIMEDIA '05: Proceedings of the 13th annual ACM international conference on Multimedia*, New York, NY, USA, pages 1043--1044, November 2005. ACM Press.

Working environment:

Students shall work as members of the TIM (Multimedia Information Processing) team at MICA Centre.

They shall be equipped for the duration of their work of a desktop PC with most common development tools and speech processing software.

They may have to use specialized audio/video hardware (microphones, mixing table, acquisition cards, *etc.*) available at MICA.

They can benefit from help from the engineers composing the API (Industrial Prototypes and Applications) team of MICA

They may communicate with local work colleagues or partners in French or English.

Student profile:

- Engineer student (final 5th year) or Master student from computer sciences field
- Vietnamese or French student (or from other countries)

Contact and direction:

MS Le Thi Lan, thi-lan.le@mica.edu.vn

Project n° 15

Topic: Image and video processing

Indexation et recherche de séquences vidéo

Contexte :

De nos jours, tout le monde peut aisément rechercher des informations textuelles, dans des bases de données ou sur Internet. Mais rechercher des informations précises dans des images, et particulièrement dans les vidéos, dans des bases de données (ou sur Internet) est toujours très difficile. Nous souhaitons donner une vidéo en requête à un système et retrouver toutes les vidéos similaires à cette requête. Ceci est notre soucis majeur dans la recherche en indexation et recherche d'images et de vidéos. Un travail actuellement en cours a déjà permis de construire un système d'indexation et de recherche d'images fixes. Nous voulons maintenant étudier l'indexation et la recherche d'information vidéos afin de continuer la recherche dans ce domaine. Le concept d'indexation de vidéos concerne les techniques pour stocker et indexer une vidéo dans une base de données pour la structurer, tandis que le concept de recherche d'images concerne les techniques pour extraire les vidéos semblables à une vidéo requête dans cette base de données (structurée ou non).

Pour les deux opérations (indexation et recherche), nous avons besoin de trouver les bons descripteurs pour identifier et caractériser les vidéos. Cette recherche peut s'appuyer sur les résultats déjà obtenus dans le domaine de l'indexation et de la recherche d'images fixes. Mais il faudra développer de nouveaux descripteurs et de nouvelles méthodes spécifiques pour les vidéos. Le couplage des méthodes d'indexation et de recherche des images fixes et des vidéos est envisagé aussi.

Une base de vidéos courtes exploitable pour la recherche sera constituée pendant le stage. Les vidéos visées seront des courtes séquences MPEG prises par des appareils photos numériques. Ceci permet de viser des applications de type grand public.

Travail à faire :

Théorique : Beaucoup d'articles scientifiques ont été écrits dans ce domaine au cours des dernières années. L'étudiant doit identifier les travaux principaux et construire un état de l'art complet en la matière.

Pratique : Développer une méthode nouvelle et originale pour rechercher des vidéos dans une base de données. Ce système doit exploiter les différentes caractéristiques des vidéos, et aussi sur les mécanismes d'amélioration des requêtes, tel que l'interaction avec l'utilisateur. Le système doit fonctionner sur une base pré-indexée ou sur des vidéos brutes. L'implémentation se fera en C++ sous Windows. La qualité du code C++ conçu sera surveillée, car il faudra intégrer le code développé avec d'autres applications.

Références :

- R. Mégret and J.-M. Jolion. Tracking Scale-Space Blobs for Video Description. IEEE Multimedia, vol 9, no 2, 2002.
- G. Boccignone, A. Chianese, V. Moscato and A. Picariello. Using Attention for Video Segmentation. Proc. of International Conference on Pattern Recognition, p. 838, 2004.
- W. Ren and S. Singh. Video Sequence Matching with Spatio-Temporal Constraints. Proc. of International Conference on Pattern Recognition, p. 834, 2004.

Conditions de travail :

- L'étudiant travaillera au sein de l'équipe TIM (Traitement de l'Information Multimédia) du Centre MICA.

- Il aura à sa disposition pendant toute la durée de leur stage d'un ordinateur PC Pentium performant, avec un environnement logiciel Praat complet

- Il bénéficiera aussi de l'aide des ingénieurs de l'équipe API (Applications et Prototypes Industriels) du Centre MICA.

- Pour le travail, l'étudiant pourra utiliser l'anglais ou le français pour les discussions avec les différents partenaires internationaux du Centre MICA impliqués dans le projet.

Contact et encadrement :

L'encadrement sera assuré par MS Le Thi Lan, thi-lan.le@mica.edu.vn . Une réunion hebdomadaire dans les locaux de MICA sera prévue pour assurer un bon suivi de l'étudiant

Autres informations

Ce stage est prévu pour un étudiant de niveau master en informatique (ou autre spécialité similaire avec fortes compétences). Les étudiants provenant de la faculté des technologies de l'information (FIT) de l'IPH sont privilégiés, mais un étudiant provenant d'une autre faculté et démontrant un bon niveau de programmation peut être considéré.

Projet n° 16

Topic: Advanced Instrumentation & Pervasive Environments

Ambient computing for the University

Virtual services on PDA/smartphone for Smart Campus

Context:

Electronics and micro informatics are constantly developing and soon to be found in all public and industrial areas. In the last years, the development of wireless networking technologies (Wifi, Bluetooth...) has made it economically and technologically feasible to develop advanced domotics and "building-otics" solutions.

That is why more and more research is dedicated to the use and integration of new "smart" technologies to adapt to the developing needs of human users. **Perceptive environments** are thus developed in such varied domains as tele-medicine, collaborative workspaces, e-learning, or advanced human-machine interfaces.

One of the potential applications of those new technologies consists in taking advantage of the widespread use of a wide range of mobile devices (PDA, smartphones, UMPCs...) equipped with wireless communication to present a user with contextually relevant information in real time. The mobile device thus becomes an interface to a global, powerful environment / server. Relevant, personalized data is sent directly to the user through a wireless connection.

We wish to use such technology to propose online services to students, teachers, researchers and administrative staff of a university campus. The project aims at building an information server analyzing user profiles and proposing them services adapted to their needs, uses, and current situation as detected by sensors in the environment. Those services shall be distributed in the most easily and widely accessible manner, as dynamic web pages. One particularly important point to consider is the work necessary to council personalization of content with protection of privacy, and authentification and data protection shall be absolutely secure.

A first work has been conducted to identify the set of usable technologies and pinpoint the difficulties inherent in integration heterogeneous technologies. In particular, a first service proposing a « guided tour » of the Campus on PDA, using GPS localization, has been developed. We wish to extend that work by complementing GPS with Wi-Fi triangulation, which works inside buildings.

Working description:

The candidate shall address during his work the following tasks:

- structure of the service and profile databases,
- securization and anonymization of the data collected in the databases,
- development of interfaces to easily insert new data in the databases,
- generation of dynamic webpages from databases and contextual information gathered from the mobile devices,

- improvement of the user localization by integration of data coming from GPS and Wi-Fi triangulation.

Project extension for a Master thesis:

The project may be extended to constitute a full-fledged Master thesis, introducing more advanced questions such as the social impact and necessary precautions needed to ensure the users' privacy and right to image, the confidentiality of the delivered data, *etc*.

Research concerning the improvement of the modes of interaction shall also be conducted: how can we improve the usability of the tool by integrating voice interaction, accelerometer data (gesture recognition), « smart localizers » connected to the mobile device, *etc.*

Working environment:

Students shall work as members of the SIA team (Advanced Information systems) at MICA Center.

They shall be equipped for the duration of their work of a desktop PC with most common development tools and speech processing software.

They can benefit from help from the engineers of the API (Industrial Prototypes and Applications) team of MICA

They may communicate with local work colleagues or partners in French or English.

Contact and direction:

M^{me} Pham Thi Ngoc Yen : Ngoc-Yen.Pham@mica.edu.vn,
M. Eric Castelli : Eric.Castelli@mica.edu.vn,
M. Nguyen Viet Tung: Viet-Tung.Nguyen@mica.edu.vn

Student profile:

- Engineer student (final 5th year) or Master student from computer sciences field or instrumentation field
- Vietnamese or French student (or from other countries)

Cooperation context:

This project is conducted in the framework of an international cooperation with Grenoble LIG, Brest ENST, and Orange / France Telecom.

Glossary:

- domotics: automation of house functions thanks to new electronic and computer technologies.
- perceptive space: place (rooms, flat, offices, campus, etc.) equipped with measurement, recording and communication devices to interact with the user and take his actions into account.

Project n° 17

Topic: Advanced Instrumentation & Pervasive Environments

Ambient computing for the University

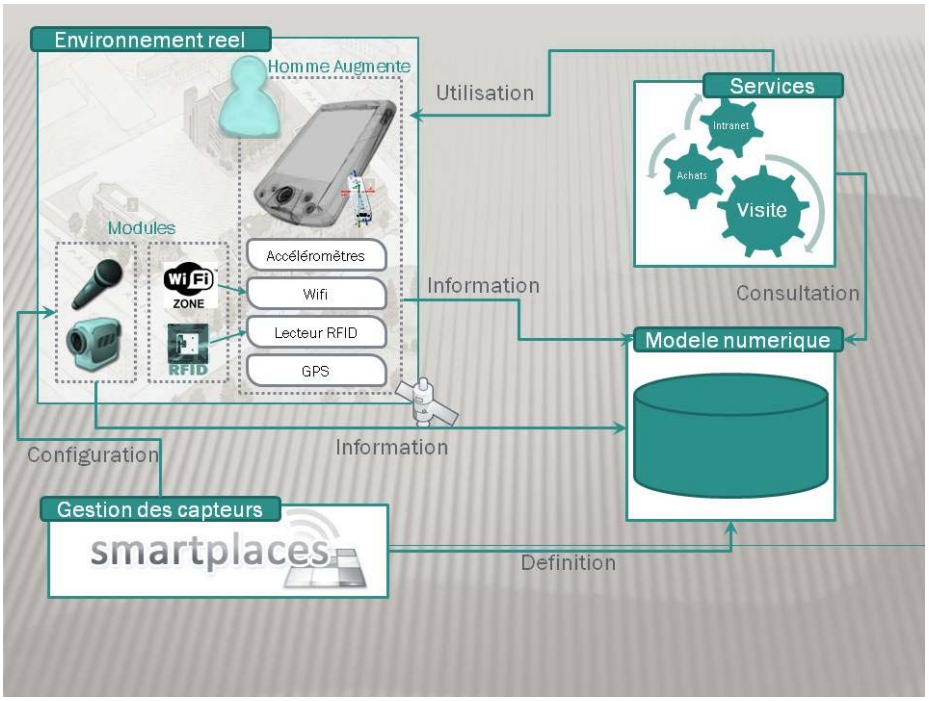
Management of a large scale perceptive environment

Context:

Electronics and micro informatics are constantly developing and soon to be found in all public and industrial areas. In the last years, the development of wireless networking technologies (Wifi, Bluetooth...) has made it economically and technologically feasible to develop advanced domotics and “building-otics” solutions.

That is why more and more research is dedicated to the use and integration of new “smart” technologies to adapt to the developing needs of human users. **Perceptive environments** are thus developed in such varied domains as telemedicine, collaborative workspaces, e-learning, or advanced human-machine interfaces.

One of the potential applications of those new technologies consists in taking advantage of the widespread use of a wide range of mobile devices (PDA, smartphones, UMPCs...) equipped with wireless communication to present a user with contextually relevant information in real time. The mobile device thus becomes an interface to a global, powerful environment / server. Relevant, personalized data is sent directly to the user through a wireless connection.



First model of a perceptive space

We wish to use such technology to propose online services to students, teachers, researchers and administrative staff of a university campus. The project aims at building an information server analyzing user profiles and proposing them services adapted to their needs, uses, and current situation as detected by sensors in the environment. Those services shall be distributed in the most easily and widely accessible manner, as dynamic web pages.

To manage a wide-scale perceptive environment, it is necessary to bring together a powerful Geographical Information System (GIS) and a specific model of the physical modules and sensors that let the server interacts with and acquires information from the environment. A first study conducted in that direction has identified the most promising existing technologies, as well as shown the difficulties inherent in using heterogeneous technologies.

Work description (engineer student):

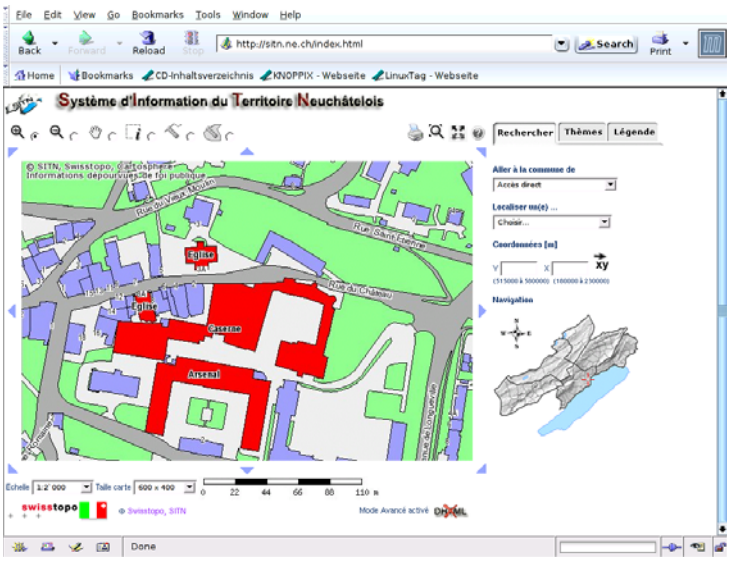
The candidate shall use existing software and develop custom solutions to allow a simple and reliable centralized management of geographic and sensor-related information, able to integrate massive information about user locations. S/he shall then build a model of the HUT campus to validate those tools.

Project extension (Master student):

The project may be extended to constitute a full-fledged Master thesis, introducing more advanced questions such as the social impact and necessary precautions needed to ensure the users' privacy and right to image, the confidentiality of the delivered data, *etc*.

Working environment:

Students shall work as members of the SIA team (Advanced Information systems) at MICA Center.



GIS example

They shall be equipped for the duration of their work of a desktop PC with most common development tools and speech processing software.

They can benefit from help from the engineers of the API (Industrial Prototypes and Applications) team of MICA

They may communicate with local work colleagues or partners in French or English.

Contact and direction:

M^{me} Pham Thi Ngoc Yen : Ngoc-Yen.Pham@mica.edu.vn,
M. Eric Castelli : Eric.Castelli@mica.edu.vn,
M. Nguyen Viet Tung: Viet-Tung.Nguyen@mica.edu.vn

Student profile:

- Engineer student (final 5th year) or Master student from computer sciences field
- Vietnamese or French student (or from other countries)

Cooperation context:

This project is conducted in the framework of an international cooperation with Grenoble LIG, Brest ENST, and Orange / France Telecom.

Glossary:

- domotics: automation of house functions thanks to new electronic and computer technologies.
- perceptive space: place (rooms, flat, offices, campus, etc.) equipped with measurement, recording and communication devices to interact with the user and take his actions into account.

Project n° 18

Topic: Advanced Instrumentation & Pervasive Environments (computer sciences)

Ambient computing for the University

GPS georeferencing solution for large scale perceptive spaces

Context:

Electronics and micro informatics are constantly developing and soon to be found in all public and industrial areas. In the last years, the development of wireless networking technologies (Wifi, Bluetooth...) has made it economically and technologically feasible to develop advanced domotics and "building-otics" solutions.

That is why more and more research is dedicated to the use and integration of new "smart" technologies to adapt to the developing needs of human users. **Perceptive environments** are thus developed in such varied domains as telemedicine, collaborative workspaces, e-learning, or advanced human-machine interfaces.

One of the potential applications of those new technologies consists in taking advantage of the widespread use of a wide range of mobile devices (PDA, smartphones, UMPCs...) equipped with wireless communication to present a user with contextually relevant information in real time. The mobile device thus becomes an interface to a global, powerful environment / server. Relevant, personalized data is sent directly to the user through a wireless connection.

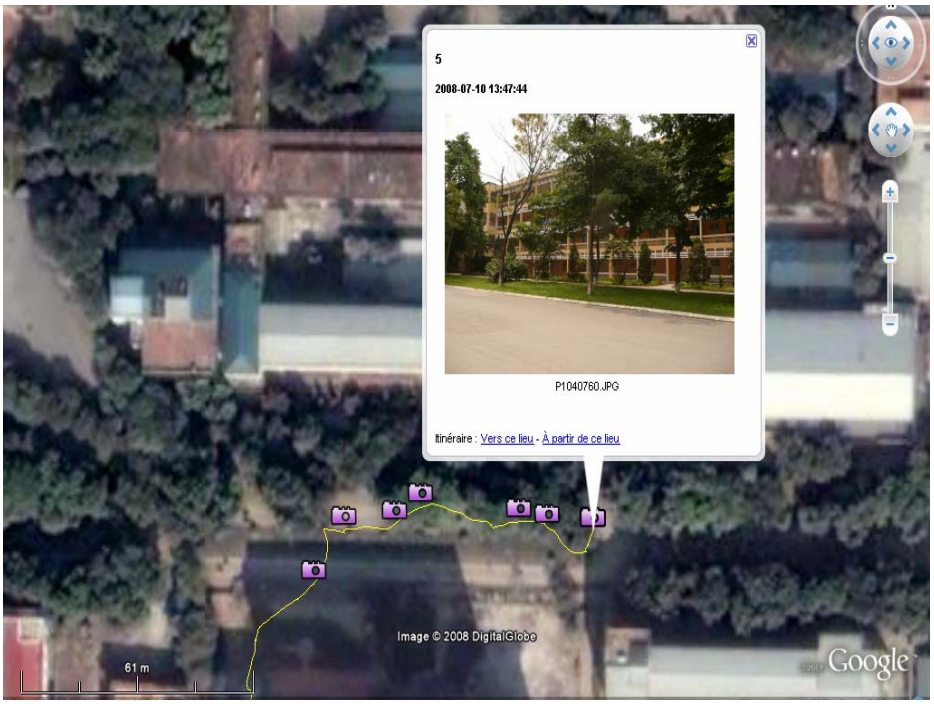
Example of one path measurement in Hanoi city

We can imagine perceptive spaces being deployed on very large areas, such as administrative zones, industrial parks, university campuses, or high-end tourist resorts.

One of the main difficulties met for this project consists in pointing precisely the location of a user in that large area. To that end, several technologies can be used simultaneously: Wi-Fi triangulation, RFID tags, CCTV monitoring, *etc*. This project will focus on GPS (Global Positioning System) technologies.

Many systems allowing precise navigation using GPS already exist in developed countries, but not necessarily in developing countries such as Vietnam. Moreover, some areas (like campuses and private zones) have never

been properly surveyed and GPS-mapped. Finally, it is important that engineers and researchers studying the problematic of user localization in large-scale perceptive spaces should themselves be able to map precisely the various building and access points.



Geolocalization of pictures in Hanoi University of Technology campus

That is why the aim of this project will be, following a previous feasibility study, will be to setup a system allowing precise GPS coordinates measurement from a vehicle (car or motorbike), and the integration of those coordinates into a geographic information system (GIS).

Work description:

The candidate shall first draw upon the main teachings of the preliminary feasibility study conducted at MICA to develop an autonomous, portable GPS positioning unit. The system shall be able to function with a notebook-type PC, or a last-generation mobile device such as a PDA or smartphone.

Working environment:

Students shall work as members of the SIA team (Advanced Information systems) at MICA Center.
They shall be equipped for the duration of their work of a desktop PC with most common development tools and speech processing software.
They can benefit from help from the engineers of the API (Industrial Prototypes and Applications) team of MICA
They may communicate with local work colleagues or partners in French or English.

Student profile :

- 5th year Vietnamese enginee3r student from the Instrumentation and Industrial informatics department,
- 5th year French engineer student with good knowledge in instrumentation and computer science.

Contact and direction:

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M. Eric Castelli : Eric.Castelli@mica.edu.vn,
M. Nguyen Viet Tung: Viet-Tung.Nguyen@mica.edu.vn

Cooperation context:

This project is conducted in the framework of an international cooperation with Grenoble LIG, Brest ENST, and Orange / France Telecom.

Project n° 19

Topic: Advanced Instrumentation & Pervasive Environments (computer sciences)

Ambient computing for the University

Using informations from new generation smartphone accelerometers for Human-Machine Interaction

Context:

Electronics and micro informatics are constantly developing and soon to be found in all public and industrial areas. In the last years, the development of wireless networking technologies (Wifi, Bluetooth...) has made it economically and technologically feasible to develop advanced domotics and “building-otics” solutions.

That's why more and more research is conducted on the development of new “smart” technologies to ease Human-Machine Interaction (HMI). One of the directions for research consists in “augmenting” mobiles devices by equipping them with sensors that can provide contextual information to the applications running no the device. 3D accelerometer sensors are becoming amongst the most commonly used of those sensors, and can already be found on many high-end smartphones, such as Apple's Iphone, or Nokia's N96.

One of the most interesting applications of those 3D accelerometers is to use them to track the inclination, orientation and movements of the mobile device and thus characterize the user's motion and gestures. The smartphone can then be used as a pointing device or a “universal remote control” to interact with applications running either on the smartphone itself [1], or on other equipments programmed to be aware of that kind of interaction, such as a small car [2] or a public info screen. In the framework of the SIAM² project, we wish to use a smartphone with 3D accelerometer as a universal remote for everyday use (e.g. household) equipments.

A first study has already been conducted, which consisted in coupling a standard PDA with a Wiimote, a game controller equipped with accelerometers. We now wish to develop a more user-friendly, streamlined interface.

First implementation

Work description:

The candidate shall study the following problematics:

- Taxonomies of user interaction tasks [Foley84, Schneiderman96, Pérez-Quinones 01]
- Human-Machine Interaction architecture models: MVC, PAC
- Develop the necessary functions to capture data from smartphone accelerometers, for example using Nokia's development tools [6]
- Using an architecture model together with the above-defined functions, build an application to remotely control lamps in a smart room using a smartphone as a remote control, with the following tasks:
    - browsing: look for a lamp,

    - selection: select a lamp,
    - command: change the state (on/off) of a lamp
- Evaluate the accelerometer signal thresholds to define to optimize maneuverability for each of the defined tasks.

Working environment

- Students shall work as members of the SIA team (Advanced Information systems) at MICA Centre.
- They shall be equipped for the duration of their work of a desktop PC with most common development tools, and a smartphone.
- They can benefit from help from the engineers of the API (Industrial Prototypes and Applications) team of MICA
- They may communicate with local work colleagues or partners in French or English.

Student profile:

- 5th year Vietnamese engineer student,
- 4th or 5th year foreign engineer student (the difficulty of the subject will be adapted to the level of the student)
- from computer sciences field or instrumentation field

Contact and direction:

Mme Pham Thi Ngoc Yen : Ngoc-Yen.Pham@mica.edu.vn
M. Eric Castelli : Eric.Castelli@mica.edu.vn
M. Nguyen Viet Tung : Viet-Tung.Nguyen@mica.edu.vn

Glossary:

MVC: Model – View – Controller
PAC: Presentation – Abstraction – Control

References:

[1] http://www.dailymotion.com/video/x3ne5f_nokmote-in-action_tech
[2] http://www.mobiles-actus.com/actualite/nokia-n95-accelerometre.htm
[3] Foley, J.D., Wallace, V.L., Chan, P. The human factors of computer graphics interaction techniques, IEEE, Computer Graphics Applications, 4(11), 1984, pp 13-48.
[4] Schneiderman, B. The Eyes Have It : A Task by Data type Taxonomy for Information Visualization, CS-TR-3665 July 1996, ISR-TR-96-66.
[5] Pérez-Quinones, M. A. Capra, R.G., Shao, Z. The Ears Have It : A Task by Information Structure Taxonomy for Voice Access to Web Pages. In Proceedings Human-Computer Interaction Interact '03, pp. 856-859. IOS Press : Amsterdam. September 1-3, 2003, Zurich, Switzerland.
[6]http://wiki.forum.nokia.com/index.php/CS000888_-_Listening_for_accelerometer_sensor_data_events

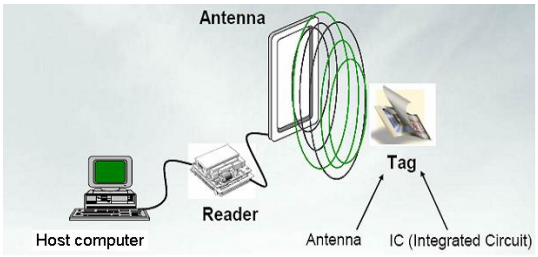
Project n° 20

Topic: Advanced Instrumentation

Nghiên cứu chế tạo đầu đọc thẻ sử dụng công nghệ nhận dạng nhãn vô tuyến thông minh (RFID).

Study and development of a tag reader using RFID technology

RFID (Radio Frequency IDentification) là hệ thống nhận dạng trong đó việc trao đổi thông tin và truyền dữ liệu được thực hiện bằng cách sử dụng năng lượng điện từ tại các tần số cảm ứng, vô tuyến hoặc các sóng cực ngắn. Đây là công nghệ mới đang được nghiên cứu phát triển và ứng dụng rất rộng rãi trong các nước công nghiệp phát triển trong những năm gần đây.



Yêu cầu kỹ thuật:

- Công nghệ nhận dạng tự động không tiếp xúc bằng sóng vô tuyến RFID.
- Kết nối mở rộng thiết bị và truyền dữ liệu thông qua mạng truyền thông không dây Bluetooth, khoảng cách truyền tối đa 50m.
- Hiển thị đồng hồ thời gian thực, ID khi quẹt thẻ..
- Tần số hoạt động: 13,56 MHz
- Khoảng cách giữa đầu đọc và thẻ tối đa 1m.
- Có thể hoạt động độc lập (stand-alone) hoặc kết nối với máy tính.

Nhiệm vụ:

- Thiết kế chế tạo đầu đọc thẻ
- Thiết kế chế tạo anten cho đầu đọc
- Ghép nối và hoàn chỉnh hệ thống
- Lắp đặt và chạy thử nghiệm

Nhân sự:

- 2 sinh viên

Tham khảo:

[1]. Klaus Finkenzeller, *RFID Handbook: Fundamentals and Applications in Contactless Smart Cards and Identification*, Second Edition. New York: Wiley, 2003.
[2]. Tan Phu Vuong, *Identification et Tracabilité par Radio Fréquence*, Maitre de conférences de l'INPG.
[3]. AppNote 403: Frequently Asked Questions about EM4095, EM Microelectronic, 2002.
[4]. AppNote 404: EM4095 Application Note, EM Microelectronic, 2002.
[5]. AppNote 411: RFID Made Easy, EM Microelectronic, 2002.

Project n° 21

Topic: Advanced Instrumentation

Thiết kế và xây dựng gói phần mềm quản lý thư viện dùng cho đầu đọc RFID

Software development for library management using RFID reader

Yêu cầu tính năng

- Lưu giữ thông tin về các đầu sách có trong thư viện thông qua ID của thẻ được gắn trên mỗi quyển sách
- Mượn/ trả sách tại quầy thông qua cán bộ thư viện
- Mượn/ trả sách tự động thông qua hệ thống tự động
- Chống trộm: Phát hiện đầu sách chưa được xác nhận mượn đi qua cửa.
- Sắp xếp sách trong thư viện: Để thực hiện được chức năng này hệ thống đòi hỏi cần một thiết bị quét cầm tay. Người thủ thư sẽ thực hiện quét một lượt qua tất cả đầu sách trên một tầng của giá sách để thu thập ID của các đầu sách. Sau đó hệ thống thực hiện so sánh các ID vừa thu thập được với các ID trong cơ sở dữ liệu để phát hiện ra những đầu sách bị sắp xếp sai vị trí. Tính năng này cho phép giảm đáng kể nhân công lao động đòi hỏi cho việc sắp xếp sách trong thư viện.

Nhiệm vụ:

- Nghiên cứu phát triển chương trình và cơ sở dữ liệu lưu trữ thông tin về các đầu sách: ID, tên sách , tên tác giả , năm phát hành , nhà xuất bản , thông tin về người mượn cuối cùng ….
- Phần mềm phải có khả năng chống xung đột (kỹ thuật đọc nhiều nhãn một lần), thông thường nhiều nhãn có thể đọc đồng thời trong trường của đầu đọc. Để có thể đọc được tất cả các nhãn này một cách chính xác, cần phải xây dựng thuật toán chống xung đột trên cơ sở thâm nhập vào mạng máy tính hoặc tren cơ sở kỹ thuật cây nhị phân.
- Cài đặt và thử nghiệm trên hệ thống đầu dọc RFID

Nhân sự:

1 sinh viên làm việc kết hợp với nhóm đề tài chế tạo đầu đọc thẻ sử dụng công nghệ nhận dạng nhãn vô tuyến thông minh

Project n° 22
Topic: Advanced Instrumentation

Nghiên cứu, thiết kế mạng truyền tin không dây sử dụng công nghệ truyền tin Bluetooth

Study and design of a wireless network using Bluetooth technology

Các công nghệ không dây thông dụng hiện nay chủ yếu là công nghệ truyền tin hồng ngoại (IrDA), RFID (Radio Frequency Identification), Bluetooth, Zigbee (IEEE 802.15.4), Wi-Fi (IEEE 802.11) hay công nghệ UWB (Ultra-Wideband). Trong các ứng dụng khi khoảng cách truyền tin ngắn và yêu cầu tốc độ truyền tin không cao thì công nghệ Bluetooth là một lựa chọn thích hợp. Đặc biệt, Bluetooth còn hỗ trợ cả việc truyền dẫn tín hiệu âm thanh

Yêu cầu tính năng:

- Sử dụng công nghệ truyền tin Bluetooth
- Dễ dàng ghép nối với các thiết bị đo và có khả năng hoạt động truyền tin với nhau theo một kiến trúc mạng
- Khoảng cách truyền 20m

Nhiệm vụ:

- Tìm hiểu về công nghệ truyền tin không dây Bluetooth
- Tìm hiểu về các kiến trúc mạng trong chuẩn Bluetooth
- Xây dựng một kiến trúc mạng truyền tin với các topology, protocol cụ thể
- Thiết kế các Module truyền tin Bluetooth sử dụng LMX9820ASM có thể ghép nối trên đầu đọc RFID của trung tâm để truyền thông tin lên máy chủ
- Port kiến trúc mạng đã xây dựng ở 3 lên các Module và máy tính PC để thực thi một mạng truyền tin không dây sử dụng công nghệ truyền tin Bluetooth.

Tài liệu tham khảo:

1. Semiconductor, "*LMX982x Bluetooth™ Serial Port Module*", April 2005.
2. *Bluetooth Specification Version1.1*
3. José A. Gutiérrez, Edgar H. Callaway, Raymond L. Barrett, "*Low-Rate Wireless Personal Area Networks*", Institute of Electrical & Electronics Enginee , November 2003.

Project n° 23

Topic: Advanced Instrumentation

Generating alerts for natural or industrial disasters through a smart multimedia terminal

Context and aim:

The aim of this project is the prevention of natural and industrial disasters

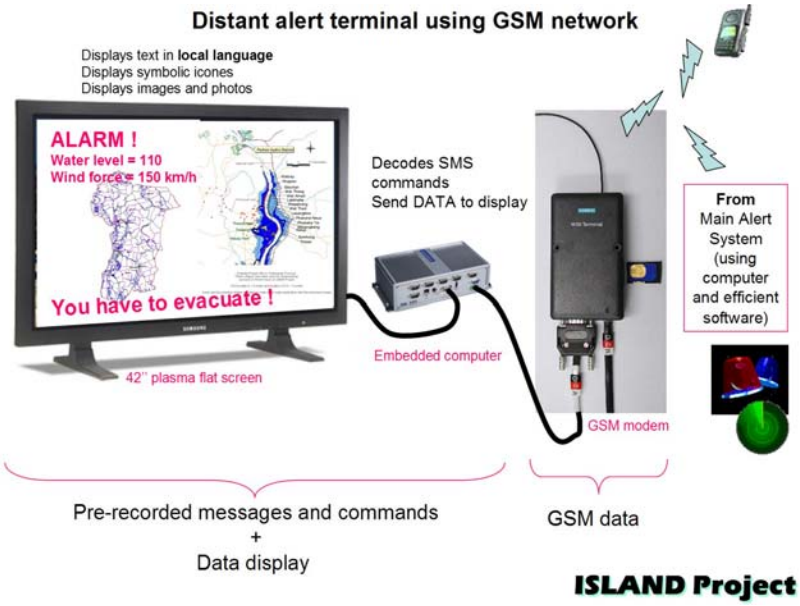
Specially developed for Asia, with a focus on floods as the main kind of disasters to take into account, the system must allow the administrative authorities of a country to quickly and efficiently alert their population of an imminent danger. The first purpose of the multimedia terminal is therefore the display of disasters alerts. However, when no emergency requires its use, it must be able to present other kind of information, such as general weather information, local news, prevention messages, or display of commercial messages.
This work takes place in the context and as the continuation of the ISLAND project. This European project in partnership with Vietnam, Lao and Cambodia has been the occasion during past years (November 2004 to June 2007) to perform on-the-spot surveys and studies to identify the needs of the populations and define the general structure of the system, as well as identify the kind of data that must be collected to make it run. Contacts have been taken with prominent partners in each country, and a few test sites (villages) have been chosen for first installations of the system.

A new project named SARDICA aims at completing the development work initiated with ISLAND to produce a reliable prototype in conformity with the specific requirements of each country. In situ tests shall then be conducted in the selected test sites, and a final seminar will be organized with all partners to present and validate the final product.

Working description:

In a first stage, the candidate will be asked to study and gain understanding of the context of the project and the existing prototype. Concerning the context, the work consists in studying the various documents produced during the first phase of the project, and, if needed, to discuss with the partners of the project. The prototype is made up of an embedded PC connected to a 42" plasma screen, equipped with both a line modem and a GSM modem to be able to answer to various situations.

After this introduction, the trainee will be expected to develop specific functional



prototype terminals for each country, taking inspiration from the general prototype and amending it to follow the constraints identified for each country. Two aspects should be considered:

- *Hardware*: the candidate will have to make proposals to attain a final product that is robust, can resist bad weather conditions and technical insufficiencies (power cuts and surges...), *etc*. We may for example consider adding an UPS, a surge protection connection, ventilation, a protection box...
- *Software*: depending on the chosen solutions, the candidate may have to develop a data acquisition application, utilities to transfer data between the different components of the ISLAND network, software to control display on the plasma screens, or self-diagnostic applications to ensure the reliability of the terminals.

Finally, the same architecture developed for ISLAND may be used in other domains: cooperation with other MICA projects (in particular the SIAM "smart space" project) is a possibility.

Requisites:

This project involves some programming in C/C++ (Qt library), as well as the use of classical web development tools (DHTML/Javascript, PHP, XML). For the interaction with the GSM modem, the (widely documented) AT command language shall be used. Interaction with partners and other members of the team shall take place mostly in English.

Working environment:

Students shall work as members of the SIA team (Advanced Information systems) at MICA Centre.

They shall be equipped for the duration of their work of a desktop PC with all needed development tools.

They can benefit from help from the engineers of the API (Industrial Prototypes and Applications) team of MICA

They may communicate with local work colleagues or partners in French or English.

Student profile:

- Engineer student (final 5th year) or Master student from computer sciences field or instrumentation field
- Vietnamese or French student (or from other countries)

Cooperation context:

This project will be conducted in the framework of the SARDICA project. Contacts have been established with the French company Wavecom, implanted in Vietnam.

Contact and direction:

M. Eric Castelli : Eric.Castelli@mica.edu.vn

Project n° 24

Topic: Advanced & bio-medical Instrumentation

Design of an accelerometer sensor

Background:

Accelerometers are sensors or transducers that measure acceleration. Accelerometers generally measure acceleration forces applied to a body by being mounted directly onto a surface of the accelerated body. Accelerometers are useful in detecting motion in objects. Accelerometers have uses in many commercial, military, and scientific applications including inertial navigation, vehicular safety systems such as airbags, ride comfort control, platform stabilization, tilt sensing, and vibration monitoring. Accelerometers find use in automobile suspension systems, vehicle air bag systems, anti-lock brake systems (ABS), vibrometers, computer hard disc drivers, smart detonation systems for bombs and missiles and machine vibration monitors.... In an accelerometer, acceleration is usually measured at a measurement point in the accelerometer, along a sensitive axis of the accelerometer. Generally, the magnitude of an applied acceleration is communicatively coupled to external instruments or circuits as an electrical impulse having amplitude proportional to the magnitude of the applied acceleration. The electrical impulse comprises the measured acceleration and is processed by the external circuits as required for a variety of applications. The electrical impulse output of an accelerometer is proportional to the acceleration, applied at the measurement point along the sensitive axis of the accelerometer. We want in this work making a sensor from an accelerometer of Analog Device. The sensor outputs can be connected with an acquisition card.

Required work:

- Understanding the application of accelerometer to measure ;
- Packing the sensor (hardware) ;
- Realization an acquisition card with SD card and PIC (hardware + software) ;
- Comparison between registered signals with references ;
- Giving a small application of accelerometer sensor ;
- Validation of results.

Condition knowledge:

- Pass the examination of knowledge
- Good knowledge in electronics: Protel, PIC, ...
- Good knowledge of programming tool: VB, VC, Matlab, C.

Working conditions:

- Student will work in the SIA team, Centre MICA.
- Student is supported a power PC, the materials, the software, documents.
- For working, students can use English or French for discussions with various international partners of the Centre MICA involved in the project.

Student profile:

- **Vietnamese** student, final year (5th year) project, Department of Instrumentation and Industrial Informatics

Contacts:

Eric Castelli : Eric.Castelli@mica.edu.vn,
Phan Duy Hung : hungbkhnmc@yahoo.com

Project n° 25

Topic: Advanced & bio-medical Instrumentation (signal processing and identification)

Identification of postures

Background:

Postures are obtained by grouping processes and motions connecting postures. Knowledge about the geometry of the artificial hand and kinematics of articulated mechanisms is applied to provide a fast symbolic representation for postures. Geometric information about kinematic multichains corresponding to hands is used for predicting and tracking evolution of symbolic representation associated to postures by describing linear symbolic models for physiological restrictions based on artificial mechanisms.

Studies of postures are very important in several applications, for example: identification of activity, drawing the human activity, diagnostic of diseases...We want to apply the general method of identification for this problem. Its result can be combined with the others studies of MICA, and can be developed in future. In this work we want to obtain a symbolic or virtual local representation for the following activities of the hand: left, right, up, down, forwards, backwards.

Required works:

- Bibliography ;
- Constructing an acquisition system ;
- Collecting a database ;
- Investigating the optimal positions of accelerometer sensors ;
- Extraction of parameters for identification ;
- Writing an identification engine ;
- Studying the problem in real-time ;
- Validation of results ;
- Conclusions and perspectives.

Condition knowledge:

- Pass the examination of knowledge
- Very good knowledge of signal processing, identification
- Good knowledge of programming tool: Matlab, VC

Working conditions:

- Student will work in the SIA team, Centre MICA.
- Student is supported a power PC, the materials, the software, documents.
- For working, students can use English or French for discussions with various international partners of the Centre MICA involved in the project.

Student profile:

- **Vietnamese** student, final year (5^{th} year) project, Department of Instrumentation and Industrial Informatics

Contacts and direction:

Eric Castelli : Eric.Castelli@mica.edu.vn,
Phan Duy Hung : hungbkhnmc@yahoo.com

Project n° 26

Topic: Advanced Instrumentation

Design of an instrumentation system for measurement concentration of Ion Pb2+ in some environment samples

Context:

As a brand of Ministry project B2008-01-210 Promoter by Researcher of MICA Centre.
Measurement method based on the solid-contact ion-selective electrode. The difference potential between the reference electrode and measurement electrode will be measured by our instrument. The originality of our method consists in a high resistance and low sensibility, low repeatability. In order to build a real application system, we propose to use new microelectronic technologies by using PSoC/ FPAA.

Request:

Using PSoC of Cypress/ FPAA of the Anadigm to develop Microvoltmeter. Convert voltage value to concentration.
In another hand the instrumentation must have the Auto calibration mode
Design of software to manage and store he data.

Working conditions:

- Student will work in SIA team (Systèmes d'Instrumentation Avancée – Advanced Instrumentation Systems) of the MICA Center
- He will use, during all the duration of the internship, a PC computer, a PSoC/FPAA evaluation card and associated software.

Student profile:

- **Vietnamese** student, final year (5^{th} year) project, Department of Instrumentation and Industrial Informatics

Contacts and direction:

Dr Nguyen THi Lan Huong : Lan-Huong.Nguyen@mica.edu.vn

Project n° 27

Topic: Advanced Instrumentation

Design and integrated system I&C (Instrumentation and Control) for kudzu powder process using SIEMENS Products

Context:

As a brand of National project KC03.15/06.10 "RECO²CONTROL", promoter by MICA Centre.

Request:

Studying a production process.
Design the process diagram of the manufacturing.
Use products of SIEMENS to integrate manufacturing.
Develop the SCADA program using the Win CC
Design and write a program for PLC

Working conditions:

- Student will work in SIA team (Systèmes d'Instrumentation Avancée – Advanced Instrumentation Systems) of the MICA Center
- He will use, during all the duration of the internship, a PC computer, an instrumentation evaluation card and associated software.

Student profile:

- **Vietnamese** student, final year (5^{th} year) project engineer student or Master student, Department of Instrumentation and Industrial Informatics
- We need 1-2 engineering students or Master student

Contacts and direction:

Dr Nguyen THi Lan Huong : Lan-Huong.Nguyen@mica.edu.vn