From a specialised writing interface created for disabled, to a predictive interface for all: The VITIPI System.

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ABSTRACT

VITIPI's aim is to increase speed text acquisition in all computer applications. Unlike the other systems, it doesn't display lists of unexpected words but provides letters without end-user's intervention. It takes into account previous words for prediction. VITIPI database is made up on texts corpora so that it is well adapted to user's vocabulary and grammar.

VITIPI was conceptualised for speech troubled speakers to increase speedwriting. Writing is essential in the *information society*, especially for troubled speakers who used it to communicate easily. But sometimes, it is also difficult for them to write easily and quickly, so it should be very helpful for them to use a writing assistance tool based on a word predictor treatment.

In a first step, we want to skim through different systems and various approaches, and we will try to point out the VITIPI characteristics, and justify our choices. In a second one, we will show VITIPI principles. Finally as an example, we will give VITIPI last results on meteorological sentences, and explain how it will be helpful for every inexperienced computer user.

1. INTRODUCTION

Who can imagine the place that takes the activity writing for persons with disabled or disorders speech? When the spoken mode is substituted for the writing mode, this becomes the only efficient mode of communication. For speakers having speech disorders, writing mode has to be quickly done otherwise the communication can fall down. So the problem clearly appears : How **could speed writing be increased?**

The performance of the speech recognition systems allows the speech mode to enter quickly text strings [Privat 00]. For users having speech troubles, this alternative communication is not usable. So you have got to use keyboards or virtual keyboards [Piwetz 95] to type your text as quickly as possible. Your keyboard, or virtual keyboard, has to be correctly adapted with special devices to the disabled user [Emiliani 96]. Nevertheless speedwriting is very low.

It should be very helpful for these disabled to have a word predictor system that writes letters (or words) on user's behalf. We shall see on the following 2.2 section that the basic principles of VITIPI system are simple: when a user is starting writing the first letters of a word, the system displays either the ending of a word or a part of it as soon as there is no ambiguity. As long as the word remains incomplete, it goes on writing as many letters as possible and automatically corrects typing or orthographic mistakes in real time, even if the word is unknown to the system.

Who can live in our *information society* without the ability of writing? Everyone is nowadays using computer to write documents, e-mails, and so on. But if you are elder or not master of keyboard, you may write very slowly and you will be disabled too! On the other hand, with new coming media like PDA (Personal Digital Assistant), mobiles, and WAP (Wireless Access Protocol) telephones, the generalised use of computer and automatic teller machine in every task life require the typing mode to interact for everyone. By the use of PDA or WAP devices based on very small keyboards/screens can introduce writing disabilities for ordinary people. So how people with special needs will be able to use these new media?

To answer to the user's needs and to consider the adaptability characteristics of a writing assistance tool, we describe the VITIPI system, as an assistant tool to write for all. In a first step, we want to skim through different systems and various approaches. In a second one, we will show VITIPI principles. Finally as an example, we will give VITIPI results on meteorological sentences, describe how it will be access on every Windows software and/or word processors, how it will be adapted to every disabled, and explain how it will be helpful for every inexperienced computer user.

2. PROBLEMATICS

2.1. Existing systems

There are different AAC (Augmented and Alternative Communication) tools for writing. One class of these tools is based on abbreviations [Derouault 83] or shorthand code[1]. The limits are that the user has to learn and to memorise a large abbreviation list.

For alternative devices such as "ManyTwo[2]" with Kalido[3] box, user has to press on simultaneous keys, which is not an ergonomic way for gesture disorders. The systems [Hunnicutt 85], [Bertenstam 95] and [Maurel 00] are displaying a list of words on the screen, then the user has to select one of them. This approach is disturbing for the user because he has to read the words list (which could be often out of context) and then he could forget the sentence he wants to write. These systems don't offer function to write a word that does not belong to the list. In consequence, they don't integrate neither orthographic or typographic checking procedures. Another inconvenient concerns the introduction of new words which needs to enter grammatical attributes of words [Godbert 93], [Pasero 98a, 98b].

For severe handicapped communication, alternative communications based on iconographic language can be used like described by [Brangier 97, 00] and [Pino 00]. These are very useful to display quickly usual and daily sentences. Their limitations concern the semantic relation between the concept and the mental representation as well as the vocabulary size and the grammatical possibilities to build sentences.

At the end, we could notice that many word predictors are linked to specialised word processor. If the user wants to use a commercial editor or web browser, he can't use its predictor.

Looking outside AAC devices, we can find a kind of prediction for mobile phones. With mobile phones, each keypad number can display three or four letters. Pressing one time on "1" displays "a" two times on "1" gives "b", and so on. The Nokia 3.110[4], 7 210[5] or Siemens T9[6] Mobile phones allow you to type only once on each keypad. Each time it displays the most likely word it finds in its database. For example, if you want to type : "*easy input*", Nokia successively displays : *e*, *da*, *far*, *easy* , *easy i*, *easy in*, *easy hop*, *easy inpu*, *easy input*. It could be noticed that user may be disconcerted with all these changing suggestions. There are no predicted letters even in the ending word. Furthermore, if user makes typing or orthographic mistakes, he can not find its word.

2.2. VITIPI principles

During the specification phase of the VITIPI system, we have tried to keep in mind the running limitations of the previous systems disagreements. The VITIPI's aim is to increase the text writing speed. Unlike the others systems, it does not display lists of unexpected words but displays letters without end-user's intervention. VITIPI knowledge base is made up with user's corpus so that it is well adapted to user's vocabulary and to sentence structure (i.e. grammatical rules and semantic topics). VITIPI system integrates checking, prediction mechanisms for word known and inference for unknown words. The prediction is based on the modelling of the previous context (characters or words). When VITIPI is facing with an unknown or unexpected word containing typing errors or/and orthographic mistakes, unlike the other systems, it can predict the end of the word, thanks to inference procedures [Boissière 96]. The VITIPI system will not be linked to a devoted word processor, it will be able to run on all windows applications.

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[1] Shorthand for windows : http://www.pcshorthand.com/
[2] Many-two : http://www.egi.fr/CMS/Download/Kalido/ManiTwo/Kalido_ManiTwo.HTML
[3] Kalido : http://www.egi.fr/CMS/RetD/Projets/Kalido/Kalido_D10.html
[4] Nokia 3.210 http://www.nokia.com/phones/3210/serious/predictive.html
[5] Nokia 7.210 http://www.nokia.com/phones/7110/phone/new/predictive.html
[6] Siemens T9 http://www.T9.com

For instance, in a running context of isolated French words (e.g.. without taking into account the word context), VITIPI was able to display *26 % of predicted letters* on a vocabulary size of 5,930 words. *72 % of typing errors* and *75 % of orthographic mistakes were corrected*. Different tests were conducted on isolated word corpora. The main conclusion can be expressed as follows: there is a relation **between the vocabulary size and the ratio prediction** (*predicted letters divided by total letters*). More the vocabulary size grows, more VITIPI's system will be faced with ambiguities, and the ratio prediction goes down. VITIPI system will have to wait for the user's letters to clear up ambiguities. Inversely, more the vocabulary size decreases, more the ratio prediction goes up. If we want to increase the ratio prediction, we have to reduce the vocabulary size without hindering the user. To reduce theses inconveniences, a solution based on the use of contextual linguistic information can be developed. It is important to outline that after a words (characters) succession, a very small set of words (characters) can be predicted. Our system uses this property to build the set of words that could be written at this very instant.

To implement these principles, various procedures and functions were built. One creates from a corpus, an adapted knowledge treelike structure called *transducer*, well adapted to realise letters prediction with isolated words. When system is faced to an unknown or misspelled word, five specialised inferences (for more details, consult [Boissière 90a, 92] were developed based on the transducer implementation. To take into account previous words for prediction, we have added a kind of *N-gram* model [Lesher 99]. Opposite of *N-gram* methodology, we don't compute the number of words, 2-gram, 3-gram, etc… The principle relies on the storage of all *N-gram* (N <= 10) in the same *transducer*: One can consider words of corpus as "*letters of an alphabet*". Sentence is a string of words. If words become "*letters*", then sentence can be seen as a "*word*". Thus, words of the corpus become an input of the transducer. So letter and word predictions are realised by a single structure. One can be feared that this structure quickly grows at an exponential rate. To avoid the increasing size of the structure, minimisation mechanism is automatically done. This procedure can operate on beginning of words or sentences. A procedure that factorises the ending of words and sentences had been developed, it does not introduce unexpected words or sentences in the system. Finally, as for isolated words, specialised inferences were developed to take into account sentences or strings of words that don't belong to corpora. All these procedures and functions were already described in various publications ([Boissière 90a, 90b, 96, 00], the lecture will refer to them for more details.

Now VITIPI is an assistant software compatible to WINDOWS API. Then, it will be considered as a virtual keyboard so that it could be used with every PCs soft (*words processing, spreadsheets, web browsers…*).

3. VITIPI RESULTS

Our aim is to evaluate the VITIPI system when it is faced with unknown situations (*new sentences*), but also to estimate its adaptation abilities. To do this, we daily take the weather forecasting on the French web site of METEOFRANCE [7].

First day weather forecasting text was introduced in the system in order to create the first version of the transducer, which then had been minimised. This first transducer was used for simulate writing of second day weather forecasting. New words were computed with the rate of input letters user typed. First and second days weather forecasting texts were joined to build a second transducer. This second transducer was used for simulate writing of third day weather forecasting and compute the same parameters. The same process was repeated until 19th transducer was obtained and used for simulate writing of *20th* day weather forecasting. Finally, the following results were provided.

When first transducer simulates writing of second day weather forecasting, system displays *16 %* of output letters with isolated words (figure 1). By the opposite, if system takes into account *9* previous words, it displays *17.5 %* of output letters. In the same way, when *19th* transducer simulates writing of *20th* day weather forecasting, system displays *29* % of output letters with isolated words. On the contrary, when *9* previous words are taken into account, system provides *44 %* of output letters.

It could be feared that those results are typical to a domain-specific meteorological corpus, and they will be different with a general language. To test it, we have added a basic French lexicon that contains 5,930 useful words. It could be noticed (figure 1) that if we consider isolated words, results are 6 % lower than those obtained without basic lexicon. If we take into account 9 previous words, results obtained with basic lexicon are only *2.5 %* lower than those obtained without lexicon.

[7] http://www.meteo.fr/temps/index.html

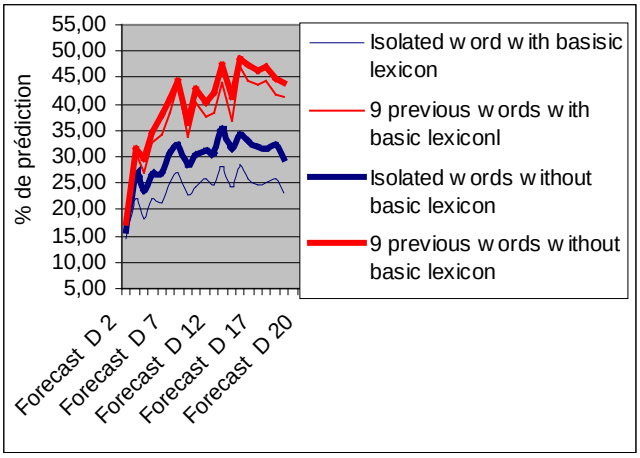

Figure 1 : Part of lexicon in prediction rate
(**with unknown sentences**)

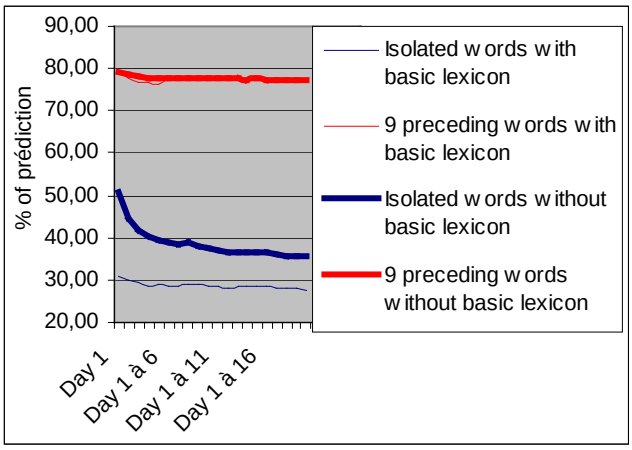

Figure 2 : Part of lexicon in prediction rate
(**with known sentences**)

If now we use transducers to rewrite their own learning corpus, all sentences are known. When basic lexicon isn't used, results (figure 2) are *35.5 %* with isolated words, on the other hand we have got *77%* with previous words. If now basic lexicon is added, results are *8 %* lower with isolated words, but with 9 previous words they are unchanged.

Taking into account previous words is very useful fore prediction rate. We also have to outline hat if we add a basic lexicon, the results are worse with isolated words than those with previous words. It seams that system with previous words doesn't need basic lexicon.

First VITIPI version that only runs with isolated words, was tested in a specialised French secondary school [Dubus 96], and a match was made with HANDIWORD. For low level pupils (6° 5°), HANDIWORD was preferred because they don't have good mastery of writing and it is easier for them to select displayed words. By the opposite, high level students (from 4° and upper) find VITIPI better than HANDIWORD. They understand VITIPI functions and use them very well. It has been proved that VITIPI increases twice or three times student speed writing.

4. CONCLUSION

At the beginning, VITIPI project was built for disabled people. It has been explain in the introduction that this system will be very helpful for everybody. Like inclined planes, remote controls, special devices made for disabled are very helpful and useful for everyone. So we have got to continue to make special devices and to carry research on disabled and elder people.

ACKNOWLEDGMENTS

The authors would like thanks to their colleague, N. Vigouroux for their various comments and discussions during the writing process of this paper.

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