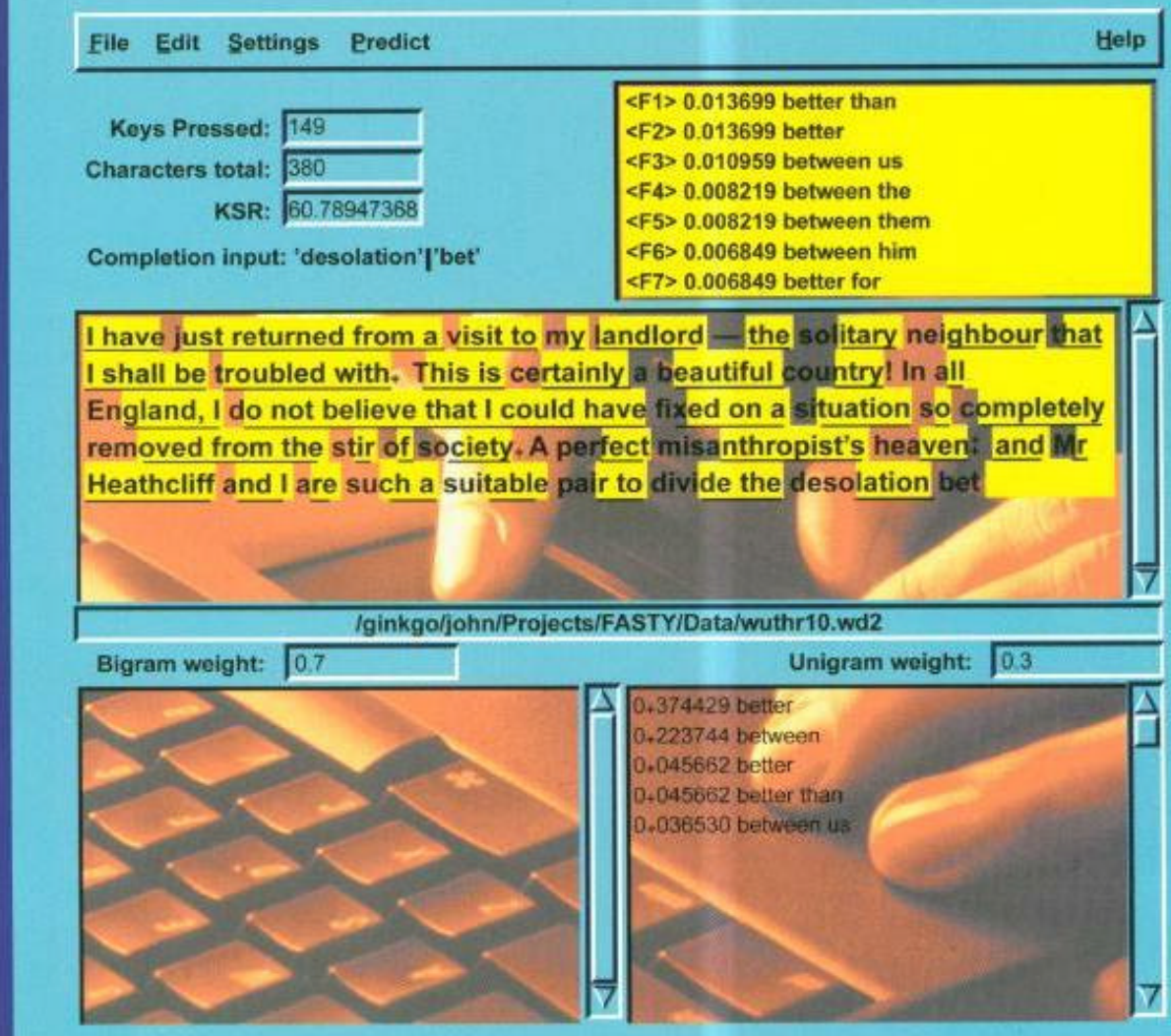
November 2001
ISSUE 40

Ability

The ICT Magazine About Disability Issues



Getting up to speed with FASTY

Plus: Shame of FTSE findings • ITCH celebrates • Reading system aids dyslexic people

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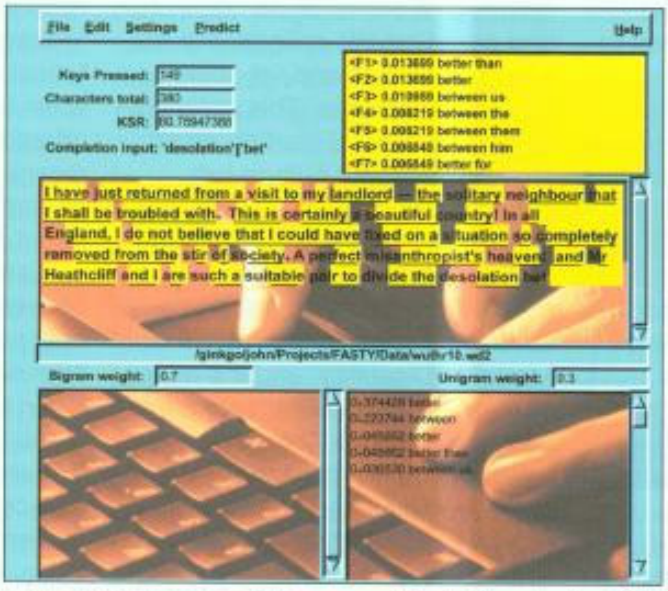
Speeding up input

FASTY, a project started in January and funded by the EU's IST Programme, is aimed at helping disabled users improve communication by increasing their text production rate. Harald Trost, from Austria's leading AI research centre OeFAI, explains.

Information exchange is vital in human society. Communication disorders, therefore, severely influence the quality of life. Impairments, which lead to a reduction of communication speed, cut a person off from equal participation in the information society.

Experienced typists produce up to 300 keystrokes per minute. Impaired people can only achieve much lower rates. A wide range of disabilities, from speech production disorders to other motor impairments, make the use of standard text input devices difficult. In severe cases character entry speed may drop below five characters per minute if, for instance, a mouth-stick, scanning system or similar device needs to be used.



Automatic speech recognition could offer an alternative to manual typing, but motor impairment often goes together with articulatory deficiencies, so in these cases speech recognition methods are useless. Often speeding up text input is the only way to allow human-like communication, and some people must totally rely on typing, even in situations usually reserved for oral communication.

FASTY (FASt TYping for improving communication speed) targets the development of a system to increase the text generation rate (TGR) of impaired typists for several European languages. The consortium carrying out the project consists of nine industrial and academic partners from Austria, Belgium, Germany and Sweden. These partners supply expertise in the areas of human language technology, software development, electronics, human computer interfacing and rehabilitation technology.

Improving typing speed

A range of software products already exists to help impaired typists speed up text production. Early products mainly used abbreviation expansion strategies, where words or phrases can be recalled by the user by entering a short code, for example, typing 'dms' could stand for 'Dear Madam or Sir'). Programs such as this yield high keystroke saving rates (KSR) when used for predefined phrases or pieces of communication. They offer little or no advantage for the generation of freely formulated text.

An alternative strategy is to exploit the redundancy of language. Low-speed typists can be supported by systems that attempt to predict portions of text by analysing what has already been written. The system proposes a selection list of possible continuations of the text. When the user sees a desired item in that list, he or she will stop entering single characters and pick the word(s) from the selection list.

Predictive typing (PT) systems offer 'word completion (the computer presents a list of words starting with the characters the user has keyed). 'Word prediction' (words are predicted even before one if their characters has been typed) and sometimes even 'multiple word prediction', where the system attempts to predict sequences of words or entire phrases from the context.

State-of-the-art programs for PT claim keystroke saving rates (KSR) of up to 75 per cent, but this does not mean that the text generation rate (TGR) increases by the factor four. Using PT consumes time for reading the selection list and making a decision. The longer the selection time and the faster the keystroke rate, the higher the KSR needed to increase the TGR. For

instance, to double the TGR of a typical mouth-stick user the program must offer a KSR of about 65 per cent.

At present such high rates can only be achieved for the English language. Almost all available PT programs originate from English speaking countries. By transferring these English language programs to other languages (especially highly inflected ones), the KSR drops significantly (usually below 30 per cent). Therefore, most motor/speech impaired persons will experience no gain in TGR from existing programs.

The FASTY System

The FASTY system sets out to produce prediction lists as precise as the ones of comparable systems for English. This goal is not a trivial one, as the languages involved in the FASTY project – Dutch, French, German and Swedish – are all inflecting languages, which means that many more words can take different forms - depending on the syntactic context – than in English, so the techniques usually employed in PT systems are not as effective. Additional and new techniques will therefore have to be developed. Some of these techniques may also be used to further improve future PT systems for English.

The market for the FASTY system is quite large. It is estimated that approximately 3.1 per cent of the European population suffers from some kind of speech and language impairment. This market, however, is fragmented due to the different European languages and because of the different manifestations of speech and language impairment and their possible combination with various forms of motor impairment.

To cope with this, the FASTY system is built in a modular way. Several language modules, covering countries with a population of approximately 200 million people (Germany, Switzerland, Austria, France, Belgium, The Netherlands, Sweden), will be developed during the project. The holistic approach to include the user interface and a user ability assessment tool into the whole development process opens up a market for FASTY of many more users than a product designed for one specific speech-language impairment or products. This does not even take into consideration the different types of motor impairment.

FASTY Innovations

A holistic design approach will be used to improve the user interface. Innovative and ergonomic user interfaces (UI) for various existing input methods – standard keyboard, on-screen keyboard (OSK), scanning – will be developed together with the predictor, thus minimising time and effort for selecting the desired word from the selection list on the screen. This task reduces the time for moving the user's attention from the input device to the on-screen selection list, finding out if the list contains the desired word, making the right decision and shifting the attention back to the input device. This will be achieved by developing arrangements between screen and input device (positioning of the keyboard or switches, arranging the OSK), which require minimum distances with respect to attention and focus shifting and by designing layouts for the selection list which support shorter reading and decision-making times. Also, a special pressure sensitive switch/keyboard will be developed and used to improve the UI. Strategies for optimal exploitation of residual functions will be implemented.

On the prediction side the usual language modelling techniques employing n-gram models of word forms will be supplemented with methods that are more sensitive to syntactic constraints. Being able to predict the correct inflected form has two benefits. First, the user is not annoyed with predictions that are syntactically impossible, and second, by leaving out impossible forms more room is left in the prediction list for other possible continuations, so that convergence to the continuation intended by the user is achieved earlier.

It is a well known fact that word probability is not independent of context. Word n-grams yield only a rough approximation of this variation. There are also lexico-semantic and topic-specific factors influencing word distribution. So-called 'recency' adjustment is a special case of this phenomenon. Different approaches, such as collocation analysis or trigger pair identification, will be explored to collect statistics that may help in finding the most probable predictions. The use of these statistics and their integration in a prediction system is another innovative aspect of the FASTY system.

A special challenge for word completion and prediction are compounds that can be created on the fly, thus making it hopeless to strive for a complete lexicon. Compound formation is highly productive (the analysis of a 27 million word newswire corpus showed that almost the half the 530,000 different word types occurring in that corpus were compounds). New methods will be developed to dynamically predict compounds not in the lexicon.

FASTY will not be limited to interact only with specific application software. Moreover, the predicted texts finally generated by FASTY from the original user input will appear for any application program as if entered by the standard keyboard. Therefore, there will be no limitation for using FASTY with any program which allows it to run in a parallel window. ❑

Further information on the FASTY project can be found at www.fortec.tuwien.ac.at/fasty