Efficient Text Entry
Executive Summary

1. Motivation

The range of electronic devices which don't provide a full keyboard is increasing (e.g., cellular phones, palm- and watch-sized devices). This deficiency imposes the challenge of efficient alternatives to typing with a full keyboard.

The same problem has to be tackled by motor impaired persons. It holds in general that typing is slow and cumbersome for these users. Persons with motor and speech impairments unconditionally depend on typed and synthesized utterances produced by a communication aid in order to communicate.

Similarly, typing of Asian languages with huge alphabets such as Chinese requires suitable and efficient methods to access all the letters with a standard keyboard.

In all these application areas, various text entry methods have been suggested to provide a more efficient input of texts with lower motor demands. Usually, they combine specific typing devices with methods that aim at reducing the number of necessary keys or keystrokes, respectively. Among these are word prediction, abbreviation expansion, ambiguous typing, text compression and text compansion (i.e., short telegram style or even pure semantic concepts are automatically expanded into complete sentences).

At their core, these methods rely on statistical and to a lesser extent rule-based language models to predict and complete the user input and thus save keystrokes. Unlike in speech recognition, the language models are also used to change and evaluate the way how to enter text.

2. Overview of presented topics

In this seminar, we invited researchers of the different application areas to discuss their results and ideas with the other communities in computational linguistics. The thirteen presentations covered the full range of the above mentioned areas. In the detailed discussions with every presentation, generalizations, similarities and differences of the specific viewpoints in the different application areas were pointed out.

The seminar started with basic issues and recent developments of language models developed particularly in the area of AAC (*Augmentative and Alternative Communication*) with the talks by John Arnott, Karin Harbusch and Michael Kühn.

The talk by John Arnott gave an overview of text entry and "acceleration" methods for writing and communication in augmentative and alternative communication for non-speaking people.

Karin Harbusch reported on how to shorten suggestion lists by imposing a syllabic language model instead of a word model. This approach is being evaluated with a highly reduced keyboard for disabled persons who can only manipulate up to four buttons.

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Michael Kühn discussed different keyboard layouts for scanning users, i.e. users who can only reach one to two keys. Scanning means that the keys are presented in a loop which is stopped by a button hit in order to select the currently shown letter.

The next two presentations concentrated on information bias in particular on consonants and vowels.

Kumiko Tanaka-Ishii discussed predictive text entry systems where the entry method depends on the features of language and makes predictions based on language statistics. She fundamentally verified two forms of information bias in the English and Japanese languages depending on locations, and also bias on consonants compared with vowels.

The system by Rani Nelken and Stuart Shieber accelerates entry speed by compression. In the proposed system, all vowels except those in the beginning of a word and all double consonants are suppressed during typing. Thus the underlying (ambiguous) keyboard of the system has to provide all letters.

A very important issue for all systems is the cognitive load imposed on the user. Scott MacKenzie pointed out that aiming at reducing keystrokes often goes along with imposing an increased perceptual and/or cognitive load on the user (e.g., shifting attention to browsing a list of candidate words in a word completion system). The increased cognitive load may slow down text entry more than the speed-up obtained by reducing the number of keystrokes. Thus the need to more thoroughly acknowledge and quantify attention demands in text entry interface is pointed out.

The talk by Toshiyuki Masui showed different devices for text input in the Ubiquitous Computing Age. POBOX is predictive entry device widely used by Japanese mobile phone users. Moreover it works on PDAs and computers with ASCII keyboards. It can be extended by a dictionary searching for words, phrases and abbreviations. Additionally, it can also be combined with a pictorial mode.

Johannes Matiasek delineated the language component of the FASTY predictive typing system. It was developed in an EU project and has been partly commercialized after the project. In particular, he pointed out which strategies made to the commercial version and basically for which reasons.

Poika Isokoski illustrated how to combine a gesture recognizer with a soft keyboard. The details of user interaction with these combinations have to be carefully modelled in order to reduce the cognitive and attention demands in systems where two characters can be entered by landing on a key on a soft keyboard to enter one character and then continuing with a pen gesture to enter another.

Janet Read discussed similarities between text input metrics and handwritten text input.

Oliver Völckers gave an overview of sensor and switch technology for mobile electronic devices. Upcoming new switches may require new entering methods.

Paivi Majaranta showed results from recent experiments with eye-typing that she has been working on together with Kari-Jouko Räihä. The essential problem is to find out

whether and which letter the user has fixated on and how appropriate feedback can be given to the user (e.g. by a shrinking animation of the selected letter). Another important parameter is the dwell time which sets an upper bound to the maximum number of entered letters per minute.

3. Next steps

Kari-Jouko Raiha summed up by grouping hot topics of the seminar. We started our final discussion by first collecting a spontaneous list: every participant was asked to write down one topic that he or she was most interested in, or would most like to see developed, or an approach that should be followed. All these items were preliminarily grouped (without removing duplications) as follows:

1. Items aiming at standardisation and evaluation
    a. First build and test the interface and report on the results
    b. Integrate best methods and strategies which should become freely available from any system
    c. Have automatic evaluation standards
    d. Have a standard baseline
    e. Open-source prediction techniques
    f. Make evaluation methods that work for different users and different technologies and contexts
2. Interface design
    a. Minimizing attention demand
    b. Speed up by using Pragmatics in the language model and fast navigation through suggestion lists
    c. Context-sensitive auto-adaptation for prediction
3. New requirements in system design
    a. Ubiquitous computing (in the bathtub, kitchen, car, street, etc.)
    b. New special device for input (e.g. tilting sensor)
    c. Analog text input with dial, joystick, force or position sensors
4. Further suggestions
    a. Error recovery in text entry
    b. More than sentence-wise language modelling
    c. Understanding language more
    d. What should we teach children in the school?

Our goal is to launch some collaborations or joint projects with participants of the workshop. Moreover, we plan to publish a book which highlights the range of research in text entry methods mentioned in the motivation section above.