

**05382 Abstracts Collection**  
**Efficient Text Entry**  
— **Dagstuhl Seminar** —

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**Abstract.** From 21.09.05 to 24.09.05, the Dagstuhl Seminar 05382 “Efficient Text Entry” was held in the International Conference and Research Center (IBFI), Schloss Dagstuhl. During the seminar, several participants presented their current research, and ongoing work and open problems were discussed. Abstracts of the presentations given during the seminar as well as abstracts of seminar results and ideas are put together in this paper. The first section describes the seminar topics and goals in general. Links to extended abstracts or full papers are provided, if available.

**Keywords.** Ambiguous keyboard, keystroke saving

## 05382 Executive Summary – Efficient Text Entry

This files consists of three parts:

- it first summarises the basic idea of the workshop,
- then the topic of the individual talks are delineated and
- finally the discussions are summarized.

*Keywords:* Ambiguous keyboard, keystroke saving

*Joint work of:* Harbusch, Karin; Raiha, Kari-Jouko; Tanaka-Ishii, Kumiko

*Full Paper:* <http://drops.dagstuhl.de/opus/volltexte/2006/533>

## **Text Entry in Augmentative and Alternative Communication**

*John Arnott (University of Dundee, GB)*

A concise outline of background is given on assistive methods for writing and communicating for non-speaking people, highlighting the role of efficient text entry in augmentative and alternative communication (AAC). AAC systems are designed to assist people with communication impairments to interact with others and to compose messages and other documents. Efficient text entry is therefore of great importance in AAC, in order to make it as easy as possible for text users to enter text into AAC systems. Continuing research and development is needed in the area of text entry to improve the efficacy and efficiency of AAC systems.

*Keywords:* Augmentative & alternative Communication, text input, non-speaking, prediction, disambiguation

*Full Paper:* <http://drops.dagstuhl.de/opus/volltexte/2006/519>

## **DISCUSSION: Future directions in language modeling for predictive typing**

*Karin Harbusch (Univ. Koblenz-Landau, D)*

What are hot topics for language modeling for predictive typing? Word models, part-of-speech, syntactic information, some semantics have already been imposed on making appropriate suggestions. What comes next?

## **Combinations of Gestures and Soft-Keyboards**

*Poika Isokoski (University of Tampere, FIN)*

A number of different combinations of text entry methods can be constructed. One combination that has been popular in recent research prototypes is a soft keyboard combined with a gesture recognizer. The details of user interaction with these combinations still need to be explored. I am searching for ways 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.

*Keywords:* Soft keyboard, gesture recognition, text entry, attention, cognition

## Low control predictive text entry with word completion and ambiguous keyboards

*Michael Kühn (Univ. Koblenz-Landau, D)*

### Predictive text entry and text compression

Mobile devices as well as restricted motor capabilities call for efficient text entry methods with low control demands. Techniques adopted from text compression seem relevant to answer this call by reducing the text entry effort with predictive text models. However, text entry differs in principle from Shannon's model of compressed transmission in the circumstance that the transmitted text is not encoded by a technical system, but a human. Since neither a perfect prediction model can be assumed on the system's side, nor an internalised model of the system's predictor on the user's side, the requirement of two identical predictors in Shannon's model has to be guaranteed e.g. by visualization of the system's predictions to the user. Thus, efficiency of predictive text entry is not captured sufficiently in a one-directional transmission model, but has to be measured with respect to two channels in an encoding - predicting feedback loop.

### Hybrid predictive text entry

A hybrid encoding consisting of a non-predictive part on the user's side plus matching predictions generated by the system may reduce the amount of predictions on the backchannel considerably and thus increase the overall efficiency, when the non-predictive code is internalisable by the user as well as part of the system's decoder.

One quite common instance of hybrid predictive text entry is word completion: the user enters a prefix of the intended text and the system presents one or more known prefix continuations for choice. I compare word completion with another hybrid predictive text entry method being successfully applied in the context of mobile phones: ambiguous keyboards with groups of letters on each key which get disambiguated by a predictive text model after a sequence of letter groups has been entered.

### Two-stage text entry efficiency

With hybrid predictive text entry, text is entered within two steps: 1. In the first step, the text is encoded partially and non-predictively. 2. In a second step, the user selects one of the predictions generated by the system on the basis of the input so far. Therefore, the text entry effort has to be measured on the two levels of the non-predictive part as well as on the prediction selection step. The efficiency of the non-predictive part is bounded below by the entropy of the static key assignments, the efficiency of the prediction selection by the entropy of the prediction list that is applicable to the non-predicted encoding.

The overall text input efficiency per word then divides the word entropy of the text model by the sum of key assignment entropy times the average number of needed keys per word and the prediction selection entropy. It turns out that the encoding efficiency of ambiguous keyboards is higher on the non-predictive part as well as with respect to the prediction selection for unigram and trigram text models. Further, on the interface design level, the keyboard entropy of ambiguous keyboards translates more directly into an efficiency preserving keyboard layout than word completion encoding does.

### **Cascading finite state machines**

The two hybrid predictive text entry methods are implemented as cascades of weighted finite state machines and evaluated on the Brown corpus and a large German corpus of written homeworks. Finite state machines provide a common framework for the word encoding and the text models featuring desirable properties: On a theoretical level, finite state machines are well investigated and limited in computational complexity.

From a software engineering view, cascading of weighted finite state machines gives a high level problem description of the predictive text entry task that can be varied easily and solved with efficient standard algorithms. For these purposes, the AT&T FSM library is fully utilised.

*Keywords:* Hybrid predictive text entry, ambiguous keyboards, word completion, cascaded finite state machines

## **Attention Demands in Text Entry Interfaces**

*I. Scott MacKenzie (York University - Toronto, CDN)*

The rationale for a model of text input that includes perceptual and cognitive processes is given. Reducing keystrokes is fine, but if the design imposes an increased perceptual and/or cognitive load on the user (e.g., shifting attention points or perusing a list of candidate words in a word completion system), then a new interface may not be as efficient as first thought. This argument as well as others underscoring the need to more thoroughly acknowledge and quantify attention demands in text entry interface are developed.

*Keywords:* Attention, perceptual and cognitive processes, model human processor

*Extended Abstract:* <http://drops.dagstuhl.de/opus/volltexte/2006/518>

## Eye typing

*Päivi Majaranta (University of Tampere, FIN)*

Eye typing provides means of communication for people with severe motor disabilities. Eye is a perceptual organ, it is not meant for controlling. This talk discusses how dwell time (a prolonged gaze) is different from manual selection methods (such as a mouse click), and how proper feedback may facilitate eye typing. We report the results from three experiments on the effects of auditory and visual feedback on user performance and experience during eye typing. Results show that the type of feedback significantly affects typing speed, accuracy, gaze behaviour, and subjective experience. Furthermore, the feedback should be matched with the dwell time.

*Keywords:* Eye typing, gaze-based text input, people with disabilities

## The language component of the FASTY predictive typing system

*Johannes Matiasek (ÖFAI - Wien, A)*

I describe the language component of FASTY, a text prediction system designed to improve text input efficiency for disabled users. The FASTY language component is based on state-of-the-art n-gram-based word-level and Part-of-Speech-level prediction and on a number of innovative modules (morphological analysis, collocation-based prediction, compound prediction) that are meant to enhance performance in languages other than English. Together with its modular architecture these novel techniques make it adaptable to a wide range of languages without sacrificing performance. Currently, versions for Dutch, German, French, Italian, and Swedish are supported.

Going beyond the FASTY system, it will also be shown that the language component can be easily extended for the use with reduced keyboards, just by defining key-mapping tables, without needing to change the dictionary or the language model.

*Keywords:* AAC, Predictive Typing

*Extended Abstract:* <http://drops.dagstuhl.de/opus/volltexte/2006/516>

## Human-centered compression for efficient text input

*Rani Nelken (Harvard University, USA)*

Traditional methods for efficient text entry are based on prediction.

Prediction requires a constant context-shift between entering text and selecting or verifying the predictions. Previous research has shown that the advantages offered by prediction are usually eliminated by the cognitive load associated with such context-switching. We present a novel approach that relies on compression. Users are required to compress text using a very simple abbreviation technique that yields an average keystroke reduction of 26.4

Input text is automatically decoded using weighted finite-state transducers, incorporating both word-based and letter-based n-gram language models. Decoding yields a residual error rate of 3.3% this approach yields improved text input speeds.

*Keywords:* prediction, compression, weighted finite state transducers, text input

*Joint work of:* Nelken, Rani; Shieber, Stuart M.

*Extended Abstract:* <http://drops.dagstuhl.de/opus/volltexte/2006/517>

## **On the application of text input metrics to handwritten text input**

*Janet Read (University of Central Lancashire, GB)*

This paper describes the current metrics used in text input research, considering those used for discrete text input as well as those used for spoken input. It examines how these metrics might be used for handwritten text input and provides some thoughts about different metrics that might allow for a more fine grained evaluation of recognition improvement or input accuracy.

*Keywords:* Handwriting Recognition, Text Input, Metrics

*Full Paper:* <http://drops.dagstuhl.de/opus/volltexte/2006/514>

## **A Japanese Ideogram Search System based on Predictive Entry of Strokes**

*Kumiko Tanaka-Ishii (University of Tokyo, J)*

A new lookup method for Japanese ideograms is proposed. This method is not based on the arbitrary conventions of ideograms but rather on four prototypes, consisting of horizontal, vertical, diagonal, and complex strokes. For example, the code for the ideogram Ta (here appears a Japanese character in the paper), ( ta, meaning rice field) is “h3v3”, indicating three vertical strokes and three horizontal strokes. With such codes, a non-native learner can look up ideograms even with no knowledge of the ideographic conventions used by natives. We conducted a user evaluation of this system and found that non-natives could look up ideograms faster with our system than with conventional methods.

*Keywords:* Information search system, Japanese character entry

*Full Paper:*

<http://www.kumish.net/index.html>

## Information Bias in Text

*Kumiko Tanaka-Ishii (University of Tokyo, J)*

As the target data of a text entry system is text, the innate nature of text governs how the system can operate. This is reflected in the spread of predictive text entry systems where the entry method depends on the features of language and makes predictions based on language statistics. Thus, it is important to determine the innate features of a language. In this paper, we fundamentally verify two forms of information bias in the English and Japanese languages depending on locations, and also bias on consonants compared with vowels.

*Keywords:* Predictive entry system, entry design, conditional entropy

*Full Paper:*

<http://www.kumish.net/>

## Overview of sensor and switch technology for mobile electronic devices

*Oliver Völckers (Tech21 GmbH - Berlin, D)*

Where mobile devices are used

- One-handed vs. both-handed usage GUI expands to small devices
- Many devices already feature input sensors, others will in the future Available sensor technology
- Resistive, capacitive, gyroscopic sensors and others Practical demonstrations of working models
- iPod, Laser Virtual Keyboard, MightyMouse, Mobile phones from Nokia and Siemens with gyroscopic and FSR sensors

*Keywords:* Text input, sensor, mobile phones, FSR, resistive sensors, capacitive sensors, analog joystick, T9, predictive input