

Abstract

This dissertation describes the inception, design and development of the GazeTalk system—an Augmentative and Alternative Communication (AAC) system designed for severely disabled users—and investigations in novel methods of incorporating grammatical features in statistical language models.

The iterative design research methodology is used throughout the development process. Other disciplines used are statistical language modelling, computer science and human factors (ergonomics).

I argue that research in AAC is highly relevant to the mobile text entry problem and vice versa, and offers the opportunity to research solutions that will be feasible to implement on future generations of mobile devices. I then present an analysis of mobile text entry indicating that the likely solution to the problem of low efficiency in both fields is a combination of the use of language modelling and careful interaction design and verification. In the design of the system presented in this paper, fewer input buttons, statistical language modelling and multimodal inputs are techniques that have been evaluated and applied.

Contrary to initial expectations, analysis and evaluation showed that usability and human factors often are more significant factors in performance than the efficiency of the input method. In the conducted study, simplifications of a text-to-talk system increased productivity by 15%. This provides a strong indication that the best way to increase text production rates in realistic scenarios is to strive for simplicity and clarity in the interaction and user interface, rather than opting for including every possible time-saving feature in the system. Empirical validations of potential simplifications are therefore advocated as a general design methodology.

Another potential improvement that—like simplification—might have a larger influence on efficiency than the theoretical improvement it confers is a language model that performs closer to human expectations. Informal comments from test subjects indicated that they felt that the language model in GazeTalk did not track the use of past tense, and would instead suggest words relevant for present tense.

I therefore further embark on an investigation of the feasibility of incorporating a grammatical feature—verb tense agreement—in a statistical language-modelling framework. I conclude that verb tense agreement is real, that it largely conforms to human intuition (e.g., when writing in past tense, the next verb is likely a past tense verb), that it can be incorporated in a statistical language model using simple, well-known methods, that it is somewhat dependent on the distance between the verbs and that it is largely a uniform influence, regardless of which word embodies the verb tenses in question. My analysis indicates that some significant exceptions to the general influence of verb tense agreement exist, and they are sufficiently frequent that they should be modelled separately. The thesis is concluded with a description of the programs developed as part of the GazeTalk project.