Mobile User-Interfaces for Text Input in Time-Critical, Unstable and Life-Threatening Situations

Simon Nestler and Gudrun Klinker

Fachgebiet Augmented Reality
Technische Universität München
Fakultät für Informatik
Boltzmannstraße 3, 85748 Garching bei München, Germany
{nestler,klinker}@in.tum.de

Abstract. Paper based documentation sheets are still the basis for documentation and communication in mass casualty incidents. Computer assisted emergency management, however, has huge advantages in assisting rescue workers in the emergency management processes. Entering the patient's name and first name is rather complicated because they could consist of nearly any character string. Unfortunately none of the standard input modalities can be used when taking the emergency specific requirements for mobile user interfaces into account. In emergency environments an input technique which mostly works with only one hand is required. When using hand-helds in emergencies a stylus cannot be used for various reasons. The developement of a fast and intuitive user interface for text input on the basis of the given requirements is the first step toward a mobile user interface for emergency operations.

Keywords: Mobile User-Interfaces, Text input, Unstable situations.

1 Introduction

In mass casualty incidents (MCIs) information on a specific patient is scribbled down on a paper based triage tag which is hung around the patient's neck. By using additional tally sheets the number and condition of all patients can be determined. Additionally a third document is used in MCIs, the so-called tracing service card, which is used for the registration of the involved patients. There is a high redundancy of information documented on triage tags, tally sheets and tracing cards. Due to the fact that paper based information cannot be copied conveniently in chaotic MCI scenarios, all of these three different document types are necessary despite their redundancy.

The major advantage of computer assisted emergency management is that by storing and relaying the information electronically the laborious copying of redundant information can be avoided. Usually small hand-held devices are used because laptops are too bulky to be carried around in emergency situations.

One of the major challenges when designing and developing mobile user interfaces which are adequate for the use in MCIs is the input of textual information. Touch screen devices lack of fast of intuitive input methods for textual information. In order to transfer the paper-based emergency management processes completely to mobile devices the text-input on mobile touch screen devices has to be simplified.

Usually users can concentrate on the interaction and do not have to move a stretcher with a patient lying on it while entering patient related information. They do not have to assist someone at the medication and borrow him "a third hand" in order to medicate a patient more easily. Nevertheless good documentation is as important as good medication, especially in time-critical, unstable and life-threatening situations. Textual information is a small yet important part of all information to be gathered.

2 Requirements

The primary task of paramedics and doctors working in MCIs is the triage, medication and transport of all injured patients. Besides this primary task their secondary task is the documentation of the patient's personal dates, conditions and the conducted medications. As a consequence the paramedics cannot focus exclusively on the mobile user interface and regularly have to switch between the primary and secondary task. The mobile user interface must fulfill the following requirements to be usable in emergency environments.

2.1 Single Hand Input

Usually the user performs text input on hand-helds with both his hands. In emergency environments, however, an input technique which mostly works with only one hand is required. During the triage and medication of injured patients the paramedics work in teams. Whereas the first team member focuses on the medication of the patient the second team member is responsible for the documentation. The first team member quite often needs the help of the second team member at medication. For instance the second team member has to hand instruments to the first team member and take them back after the performed medication.

When two free hands are compulsory for the proper function of the text input, the switching between these two tasks is too laborious. Furthermore the interaction with the mobile user interface cannot be continued when assisting the other team member. As a consequence the first requirement is that it is possible to proceed the text input with a single hand, accepting that the input speed might decrease by this limitation.

2.2 Finger Input

On hand-helds, interaction with the mobile user interface is typically performed with a stylus. When using hand-helds in MCIs the stylus cannot be used for various reasons. Firstly it is not possible to perform stylus-based interactions with a single hand due to the fact that the second hand is needed to hold the hand-held device.

Furthermore the stylus inhibits the seamless switching between the documentation and the assistance task, because the stylus has to be taken out of the case at the side of the hand-held before the documentation and has to be put back afterwards. Last but not least the medication and its documentation is performed in a highly unstable and chaotic environment. A small tool such as a stylus is in great danger of getting lost very easily in emergencies.

2.3 No Training

Paramedics have to be able to use the mobile user interface even if they are not regularly trained in using it. By developing complex text input modalities which are only used in this special situation, the paramedics would need regular trainings to stay in practice. Therefore mobile user interfaces which are either already well known from other fields of application or whose functionality can be understood without extended explanations are preferable. Therefore the third requirement is that even without any training the text input can be performed successfully with the mobile user interface.

2.4 Prediction-Free

In the context of text input methods for mobile hand-helds two techniques are quite common: Dictonary based and prediction based text input. Dictionary based text input modalities compare the words the user is typing with an internal dictionary. As soon as the number of possible words is limited (because the user has already typed in some characters of a specific word), the user gets one or more suggestions how the word could be completed. Usually the words are weighted according to their average frequency in written texts. This modality has three fundamental problems for name input: Dictonary totality, ambiguity and weighting. Common dictionaries do not contain all names. The completion of names is usually ambiguous and the weighting of the different names cannot be solved with a straightforward text analysis, even if the first syllables have already been entered.

3 Related Work

Silfverberg et al. proposed an algorithm which predicts the text entry speed on mobile phones. Their evaluation showed that with T9 (*text on 9 keys*) up to 41 wpm, with multi-tap (next button) up to 25 wpm and with multi-tap (timeout) up to 21 wpm are possible [5]. T9 is a predictive text input method whereas multi-tap input is performed by pressing the same key to cycle through the letters. Masui pointed out how word based probability models can improve existing text input methods for pen-based computers [4].

An extensive overview on existing text input methods for mobile computing is given by MacKenzie et al. Furthermore their overview includes the psychological background of entering text on mobile hand-helds, for instance *focus of attention* (FOA) considerations [3]. Additionally MacKenzie performed an evaluation on different soft keyboards. The participants had to enter phrases on a paper mockup for a keyboard layout and they reached word per minute (wpm) rates between 12.1 and 12.3 for a Qwerty-Phone hybrid layout.

Karlson et al. designed a mobile user interface which can be used with a single hand. Their mobile user interface, called ThumbSpace, is a software-based interaction technique that provides general one-handed handling of mobile hand-helds. Their user-study showed that ThumbSpace provides accurate selection of all interface objects, especially of smaller targets. Single hand text input methods, however, were not included in their work [2].

4 Input Concepts

On the basis of the described requirements we are in the process of developing 12 different concepts for entering textual information. Some of these concepts were inspired by literature and some were designed by ourselves. We have focused on entering surnames and first names, therefore none of the concepts includes punctuation and numeric characters. Clear rules for the capitalization of names and first names exist in emergencies (the surname is always written in capitals, in the first name only the first character is a capital).

We designed four different concepts of keyboard and multi-tap input modalities as well as four additional concepts.

4.1 Keyboard Input

Keyboard input methods have in common that all characters are directly mapped to soft keys. Consequently all 26 buttons (one for each character) are displayed simultaneously on the user interface. Due to the fact that screen space is limited when using mobile hand-helds the size of each soft button is highly restricted.

The major challenges when designing a soft keyboard for mobile hand-helds is on the one hand to guarantee that the user can click all soft buttons without any problems and on the other hand the arrangement of the buttons on the screen. When taking the requirement into account that the user interface must enable the user to input text with only one hand, the possible location for the soft buttons is even stronger restricted. It is challenging to map all characters on separate buttons even if the interaction space is highly limited. We designed four different arrangements and interaction metaphors for the keyboard input concept.

4.2 Multi-tap Input

When displaying less than 26 keys, more than one character has to be mapped to the same soft key. Multi-tap techniques are already used on mobile phones. In general two different multi-tap concepts are used, multi-press with timeout and multi-press with next button [1]. Nowadays typically a combination of both concepts is used, the selected character is either approved after a timeout of some seconds or by clicking the next button. Our implemented multi-tap input concepts differ in the number of keys and in the arrangement of the characters on these keys.

4.3 Further Input Methods

In addition to the keyboard and multi-tap input techniques we implemented four further methods for entering text on mobile hand-helds.

Entering text with the *unweighted cluster* input method is done by navigating through a character tree. Every node has up to 4 children, as a consequence up to 3 clicks are required for entering one character. In the *weighted cluster* input method the characters are sorted by expected frequency in order to reduce the number of clicks. The *list* keyboard consists of two lists of characters. The left list contains all vocals, the right one all consonants. In order to select the desired consonant it might be necessary to scroll the list in vertical direction. The *finger* keyboard uses a painting area for the character input.

5 Future Work

The goal of our future work is to identify the fastest input method for hand-helds which additionally meets our requirements. We will perform an expert review to identify the less promising concepts before we perform the user study.

In the next step we will perform a small-scale explorative evaluation to exclude additional text-input methods for single hand use from our future considerations. In the user study we will measure the time differences between the various input methods. The easier the text input method can be used, the faster we expected the users to enter the names.

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