Txt-it Notes: Paper Based Text Messaging

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ABSTRACT
Text messaging or SMS (Short Message Service) has become a ubiquitous form of communication, particularly amongst the younger generations. However, older members of society (and technophobes in general) are often excluded from communicating in this way. In an attempt to overcome this problem, and to try and help foster social relationships among family members, we have designed and implemented a paper based system for sending and receiving text messages. We describe the underlying technologies used, along with the design of the paper user interface, the simplicity of which allows the system to be used by young and old alike.

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General terms: Design, Human Factors.

Keywords: SMS, text messaging, paper user interface, handwriting recognition, gesture recognition, elderly.

INTRODUCTION

The use of text messaging has continued to grow at a staggering rate. It is reported that in September 2005, 89 billion messages were sent worldwide [20]. A number of recent studies carried out in Europe [10, 15, 17] have shown, however, that the use of text messaging by the elderly is significantly less than amongst the younger generations (about 5% of those over 67 versus nearly 70% of those aged 16-19 [15]).

The reasons behind these differences are complex, but in many ways obvious. Firstly, handset design is often driven by considerations associated with teen acceptance [2], typically resulting in devices of small physical size and complex features. For the elderly, devices of this nature are often difficult to physically operate and this compounds the already difficult task of understanding and using "new technology". Complex user interfaces requiring knowledge of nested menus, icons, soft-keys etc. can prove confusing and off-putting to the point where elderly users will quickly give up their attempts to use mobile phones.

Another reason is that elderly people were introduced to mobile phones late in their lives. Their patterns of life have existed without the use of this technology and hence they feel little need to adopt it now. This argument often goes hand in hand with their belief that they will fail to understand new technology and would rather avoid the disappointment and frustration experienced when trying.

In an attempt to overcome some of these issues, various mobile phone manufacturers including Fujitsu, LG and Kyocera have produced handsets designed specifically for the elderly. The principal of Universal Design [19] was used in the design of the Raku Raku PHONE [11], a Japanese phone with usability features, such as one touch dialing buttons, that take into account the needs of elderly and disabled people. Another recent example, designed for the same user group, is the *Life* phone [6], which has large buttons and a simple interface with a minimal feature set.

The design of our Txt-it Notes system was in part motivated by the desire to provide an SMS based technology that would be easily accessible to the elderly community. In addition, the work was further motivated by research into person-to-place and place-to-person forms of communication [16]. We were interested in investigating the use of text messaging to help foster social relationships among family members, in particular, between grandparents and their grandchildren.

Figure 1. Txt-it Notes prototype in use

The fundamental idea behind Txt-it Notes is to offer the user an entirely paper based messaging system. Using a conventional looking pen, the user writes their message on a regular pad of Post-it Notes. A simple gesture with the

pen then identifies the recipient and sends the message in a single action. A small built-in printer automatically prints received text messages, thus removing the need for any form of digital display.

PAPER USER INTERFACES

When compared to paper, digital technologies tend to present far more complex interfaces to their users. Using and understanding feedback from our actions with devices such as mobile phones often requires a great deal of learning and experience [18]. This is not to say that technology is without its benefits. However, there are situations where removing the complexity of technology from a user interface can significantly benefit the user, the less-is-more philosophy [3], particularly when the user group is from the elderly population.

The use of a paper user interface potentially circumvents many of the problems discussed earlier. People have been writing on paper for thousands of years and typically find it a natural and easily understandable means of communicating with others. Communicating over distance through the use of paper has traditionally involved posting/mailing the message, which is an inherently slow process. Faxing a message provides a faster alternative means of distant paper communication, but is typically used for place-to-place, rather than place-to-person, or person-to-place communication.

Txt-it Notes (shown in Figure 1) attempts to merge the benefits of writing directly onto paper with today's high speed SMS communications infrastructure. In so doing, it overcomes many of the complexities often associated with modern communication devices (mobile phones, computers etc.) and provides a device that is simple to understand and use.

RELATED WORK

There have been various strands of research into paper user interfaces over the past two decades, with efforts to address problems ranging from system control, document annotation, planning and messaging. This section provides a brief overview of some of this work.

Work by Johnson et. al. [12] in 1993 at Xerox PARC investigated the use of paper user interfaces for controlling a document services system called XAX. Users entered hand written information onto cover sheets, which also included machine readable glyphs. When the sheets were scanned back into the system, the hand written user input, combined with the glyph, controlled the required document services, for example scanning, faxing etc..

Paper Augmented Digital Documents (PADDs) [7] and PapierCraft [14] are examples of document annotation systems. Through the use of Anoto digital pen technology [1], they allow the user to mark-up paper documents, where the annotations are automatically transferred into the digital domain.

The Jadoo [4] system attempts to address the problem of computer illiteracy in rural India. In essence, an 'expert' user crates a paper interface (called a *Web Leaf*), which includes a bar code that references online information or a web service. A novice user then gains access to the service or information by scanning the Web Leaf.

The above systems clearly demonstrate the bridge between paper and digital realms and some of the technologies used to achieve this. In addition, the paper user interface systems described below also offer messaging capabilities.

The Paper PDA [9] was an attempt to combine the affordances of a paper based notebook/calendar/organizer with the benefits of an electronic equivalent. When changes are made in the paper version, pages can be scanned back into the system, thus allowing it to be synchronized with the digital version. Additionally, the system allows the user to compose paper-based e-mail messages, which get sent the next time the Paper PDA is synchronized.

The ElderMail system [5] is based around the *book as user interface* (BUI) approach. Using a clearly understood metaphor, a physical book with tabbed pages helps guide the user through the process of e-mailing a message in a set of simple steps. The message itself is written on a sheet of paper, which is scanned and then sent electronically.

Chatpen is a device based around the Anoto technology, and in combination with a service called Notera [21], allows the user to write messages and have them sent via either SMS or e-mail.

Although the Paper PDA offers a useful set of features, it lacks the immediacy offered by Txt-it Notes when sending messages. To a lesser extent, this also applies to the ElderMail system, due to the number of steps required to send and receive messages. The Chatpen/Notera service offers a convenient solution for sending messages, but offers no equivalent paper based means of receiving messages.

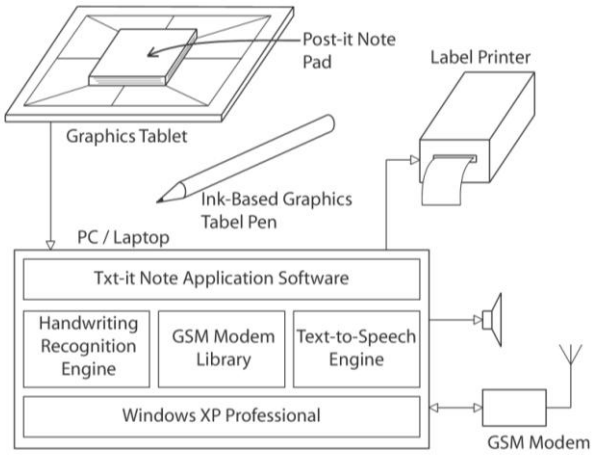

Figure 2. High level overview diagram of the Txt-it Notes prototype

DESIGN OVERVIEW

The design of Txt-it Notes centers on a re-engineered graphics tablet and stylus (Figure 2). The tablet electronics were removed from their original casing and mounted on the underside of the lid of the prototype case. The stylus

was re-engineered to incorporate an ink-based refill, but done in such as way as to maintain the exiting digital position and pressure input of the original stylus. The net result is pen/paper input combined with real-time digital stroke information.

The stroke information is fed to both a custom gesture recognition algorithm and a handwriting recognition engine. The former, which is described in more detail below, is used to recognize the *send* gesture. Once a message has been written and the send gesture identified, the message text is recognized and passed to the GSM modem library along with the recipient's phone number. Finally, the message is sent as a standard SMS.

INTERFACE DESIGN

Gesture Input

During the design of Txt-it Notes, a number of alternative gestures were considered for identifying recipients. We considered simple gestures like holding the pen tip next to the recipient's name for a short period or double tapping next to the name. These solutions were discounted as they would typically leave no visible mark on the message, an important requirement for feedback to show that the message had been sent. Another approach was to make a small tick mark next to the recipient's name, but this had the drawback of being difficult to disambiguate from the actual message text.

We chose the method of drawing a line across the middle of the Post-it Note towards one of the eight pre-set recipient names, as shown in Figure 3. This has the advantage (for the system) of being easily discernable from the message text. This idea was additionally motivated by work on marking menus [13], (albeit in a different context), which have been shown to be an efficient and reliable means of user input.

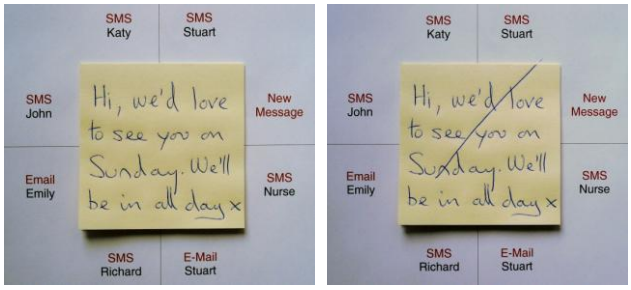

Figure 3. (a) Composed message, (b) Message sent to recipient, Stuart

The gesture recognition algorithm incorporates both temporal and spatial information derived from the user's mark. To help disambiguate the gesture from the text of the message, the line length must be at least half the width/height of the Post-it Note pad and be drawn relatively quickly. The start and end points of the line are used to determine the angle and direction in which it was drawn. This information is then used to identify the recipient from a look up table of names and numbers.

Command Input

The initial prototype of Txt-it Notes reserved one of the eight recipient boxes for a 'New Message' command. Rather than sending the message to a recipient, the New Message command has the effect of clearing any existing unsent text, thus allowing the user to start a message afresh.

This idea can be generalized as *command input*, rather than *message input* and has the advantage of making the available system commands clearly visible to the user. However, adding more commands also has the drawback of reducing the number of possible recipients. This could be overcome by increasing the number of recipient boxes from eight, to say 16, but this has the knock on effect of requiring the user to draw the send gesture far more accurately.

Message Output

When a new message is received, the sender's name, the time and date, and the message text are printed on a small sticky label, which comes out from a small slot in the front of the casing; see Figure 4. Printing the sender's name has been shown to be important [8], but in the situation where the sender's details are not known to the system, the fallback is to print the sender's phone number instead. This functionality mimics that found on most mobile phones when a new SMS is received.

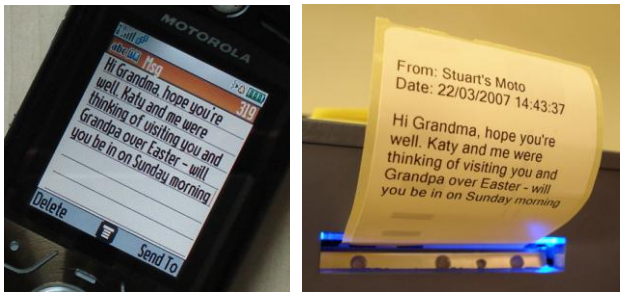

Figure 4. (a) Message being sent from a mobile phone, (b) Txt-it Notes prints the received message

Another feature of mobile phones is the SMS outbox/inbox which records a history of sent and received messages. Txt-it Notes does not explicitly support this functionality. However, the user can stick the sent and received message notes to any suitable surface, for example, on a wall, in a notebook etc. to keep a message history.

Text-to-Speech Interface

To provide additional feedback to the user, we experimented with incorporating a text-to-speech interface. In the case of sending a new message, the system was configured to speak the recipient's name and message text. This was done to provide confirmation to the user that the system had recognized the user's written input. When a new message is received, the system announces the sender's name. Initial testing has shown this feature to be beneficial, although some users found it a little intrusive.

FURTHER WORK

E-Mail

In addition to handling text messages, we also experimented with sending and receiving e-mails. Even though the under-

lying communication method was different, the user interaction remained the same, which benefits the user in that they need only learn a single interface.

However, Txt-it Notes was designed to handle short messages; an SMS is typically less than 20 words. Receiving long e-mails had the undesired effect of causing the message to be split over multiple paper labels.

An area of future research is to investigate the idea of filtering long messages, perhaps with some form of text summarization.

Gesture Recognition

An alternative approach to the *New Message* command mentioned earlier would be to recognize a greater number of gestures. For example, crossing through a word in a back-and-forth motion would cause the word to be deleted.

Another feature we have considered is to allow the user to draw two or more send gestures on the same message, thus enabling the message text to be sent to multiple recipients.

Initial Setup

The system currently requires a text file (containing the names and numbers of the recipients) to be created before initial use. This is clearly an issue as we are aiming to create a system with a purely paper based interface. Therefore, we have been investigating the addition of a *setup* mode.

This works by having the user write name and number pairs in the space around the pad of Post-it Notes. Once written, the user again draws a line on the pad towards the newly written name/number, and the system recognizes the new contact details and stores them for later use.

User Trials

At the time of writing, only limited user evaluation has been undertaken, however, initial feedback has been very positive. We intend to implement the features mentioned above before moving onto more detailed user trials in family homes. This work will clearly give us a more detailed picture of the use of Txt-it Notes and required features before moving on to develop a more refined version of the system.

CONCLUSIONS

We have reported on the design and implementation of a system that offers a paper user interface for sending and receiving text messages. Our future efforts will concentrate on user trials and building an enhanced version of the system.

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