A SURVEY OF TEXT ENTRY METHODS AND RECOMMENDED RESEARCH FOR MOBILE DEVICE INPUT WITH GLOVES IN COLD WEATHER.

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ABSTRACT

A survey of the current research in text entry is presented. Furthermore the application to a rugged all-mountain mobile device is considered, and recommended research is presented. Furthermore some discussion is given to the dual research areas of designing for disabilities, such as impaired motor skills, and the convergence with general input design for handhelds.

KEY WORDS

Text Input, mobile phones, gestures, gloves, Edgewrite, Quickwriting.

1. INTRODUCTION

The development of mobile telephony into smart devices which have the capacity for delivering an array of web content, video, GPS, email, and increasingly complex interactions is apparent[1]. With the advent of these new interactions the role of SMS text messaging has remained the second most used functionality after calling[2]. Indeed text messaging continues to increase in all markets, including the U.S, as well as the traditionally strong markets in Asia and Europe. Current statistics in the United Kingdom show there were circa 4.4 billion text messages sent in the month of December 2006[3]:

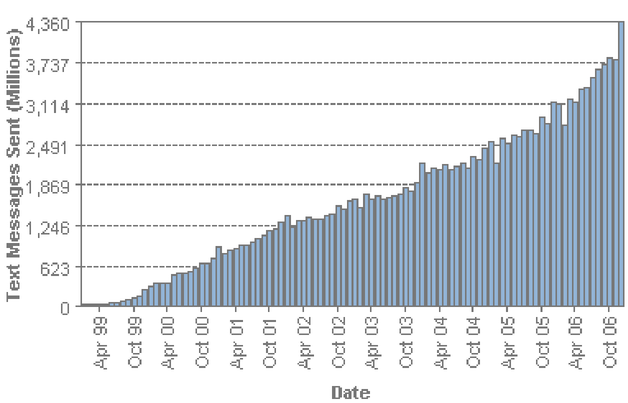

Figure 1: Increase in text messaging in the United Kingdom 1999-2006. (Mobile Data Association, 2006) [3]

Current market research predicts that by 2012 global SMS (*Short message Service*) revenues will reach $67 billion, driven by a predicted 3.7 trillion worldwide messages sent that year[4]. Despite the apparent continued increase in text messaging, as well as a related need for text input for other functionality, including email, coupled with a large body of academic research, carriers and device manufacturers continue to play safe with input methods on their lead devices. Apples' "iPhone"[5] (estimated release date June 2007) still incorporates a "qwerty" keyboard, albeit augmented:

a. **b.**

Figure 2: Old and new paradigms for text entry. **(a)** Apple "iphone" text interface. **(b)** Microsoft "XNav"[6], previously "Quickwriting", developed at New York University by Ken Perlin.

The "qwerty" keyboard as an input technique for handheld devices has a number of key shortcomings. It requires a dual Focus of Attention (FOA) as well as being predominantly carried out with two thumbs for input[7]. Academic research has provided a number of alternative entry methods, including trackball entry[8], stylus[9], isometric joysticks[10], chording [11], displacement joystick game controllers[12], optical joysticks(with fingerprint recognition)[13] and touchscreens[14]. An excellent reference point for a potential researcher would be MacKenzie and Sourkeff's *Text Entry for mobile computing: Models and methods, theory and practice*[15]. This paper also is a good reference for metrics to capture efficiency of different methodologies, along with other work by the York University research team[16].

Coupled with the *input methods* are a series of more innovative *systems* for achieving text entry, with many being capable of cross-platform, multi-device entry. Key innovators in this area, are the EdgeWrite system[17] and the aforementioned Quickwriting[18]. The established method for twelve key entry is Tegic Communications "T9", more commonly referred to as predictive text.[19]

2. MOTIVATION

The motivation for the Research was previous work by the author in conjunction with fellow students at DePaul University on a GPS device for use in the Mountain Environment. Requirements became clear that common text entry and menu navigation methods would become difficult in a cold environment with the use of gloves.

3. INPUT IN COLD WEATHER

a. **b.**

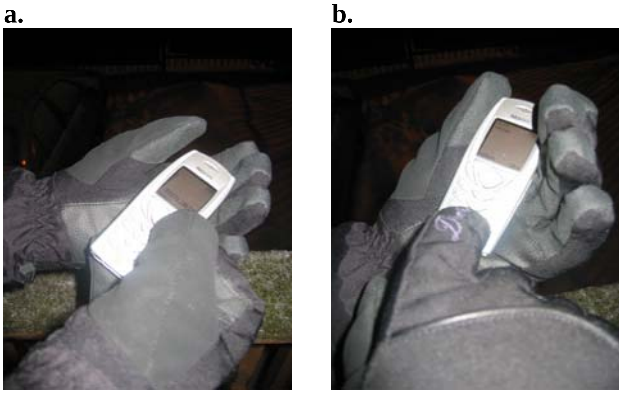

Figure 3: **(a)** and **(b):** Impracticalities of 12 key input with heavy gloves.

The purpose here is to consider a series of input and entry methodologies which would be best suited for text input in cold temperatures, where either, motor skills are reduced or there is the usage of heavy gloves.

Why Cold Weather?

The Impact of GPS on mobile device design is increasingly apparent, allowing accurate services based on mapping, personal positioning[20], and mobile social networking[21].The potential role of GPS in augmenting a users experience specifically in the setting of winter sports has been previously investigated by the author. Methods for input in such climates have been previously discussed, both in a more extreme setting, such as arctic survival[22] and some proposed solutions in more recreational settings, based on wearable computing solutions:

a. **b.**

Figure 4: Wearable solutions? : **(a)** Lena Bergin's textile mobile device[23]. **(b)** Motorola/Audex Jacket.[24]

The wearable solutions presented do not include support for text entry and complex navigation. Lena Berglin's work at the University of Boras[23], Sweden, works with gesture based controls for basic actions, such as making a call. Motorola and Audexs' Jacket is designed primarily for mp3 playback[24]. That considered gesture based glove entry has been researched and presented[25], but its use has typically been envisioned in more stable environments.

Impairment of Motor Skills In Cold Weather:

A number of studies have been completed on the physical and psychological performance of humans in cold environments, predominantly by the military[26]. Typically a definition is made between surface cooling, such as numbing of the fingertips and deep body cooling, referencing the body's core temperature (typically measured in the rectum). Manual performance and manipulation are certainly compromised by heavy gloves, but this is further affected by the loss of flexibility in the forearms and fingers due to an increase in muscle viscosity [26], and problems bending joints due to the increase in the viscosity of synovial fluid. Dexterity measures used in such studies include the Grooved Pegboard Test, predominantly carried out in the U.S by the University of Minnesota's Hypothermia and Water Safety Laboratory in Duluth, Minnesota. Work by both Mackworth and Morton and Provins are particularly relevant and revealing to the present study, in which finger numbness was measured. Mackworths' study[27] of exposure to wind-chill as low as -35 degrees Celsius revealed that numbness occurred as early as 1.2 minutes exposure time, primarily a function of wind velocity. Morton and Provins work[28] involved reducing the hand temperature from 32.5 degrees Celsius to 2.5 degrees Celsius. Numbness was observed following 3-4 minutes exposure, and showed acceleration when hands were cooled but the body was kept warm.

A Note on *Cognitive Process* and Cold Weather:

Although the effect of even moderate cold on motor skills is clear, the same can not be assumed for cognition and information processing. It would be fair to say this is still an area of medical and psychological debate, and the reader is directed to Hartley and McCabes' outstanding research and summary on this topic[29].

4. MOBILE DEVICES AND MOUNTAIN SAFETY

Although it is not apparent that any academic studies have been carried out, there are a number of industrial cases, including officially filed reports by mountain rescue, of the interference of mobile devices with traditional search locators such as digital avalanche beacons in avalanche burial situations. One such incident at Pra-Loup Ski resort, France, reported that the "search-mode" of ARVA 9000[30] and Ortovox M1 Avalanche[31] transceivers had been affected by a GSM Mobile Phone and as such had delayed the location of a buried skier[32]. Typically search and rescue teams will demand "radio silence" when carrying out a rescue.

Figure 5: Avalanche beacons and Transceivers are carried by Mountain Sports enthusiasts both for near and off-piste activity.[31][32]

In contrast mobile phones which are switched can give a stronger signal to a passive Recco receiver[33], which are typical for piste and near piste skiing activities. At least one victim is recorded to have been located solely on the basis of their mobile phone, in Avoriaz, France[34]. For the purpose of this study this highlights the vital consideration of *compatibility*. Integration of the mobile phone as an essential component of an extreme skiers equipment is dependant on testing and proving its reliability and effectiveness in rescue situations, as well as more casual mountain communication.

5. CONCLUSIONS AND FUTURE WORK

This paper has sought to survey current input methods and text systems, as well as considering the application to a device for extreme conditions, in terms of both design and safety issues. Furthermore presented are a series of research recommendations in order to progress with the current cold weather paradigm and present issues for designers and researchers in related fields:

i. Joystick Input:

On the basis of the research surveyed it is the recommendation of this study that a joystick based input has the potential to be most desirable for the current design paradigm. It is beyond the scope of this paper to analyze the comparative merits of isometric input compared to displacement or optical input. Indeed optical input is currently an emerging technology, with little market implementation. That considered its clear advantage in providing both *aesthetics* and *functionality* warrant further investigation.

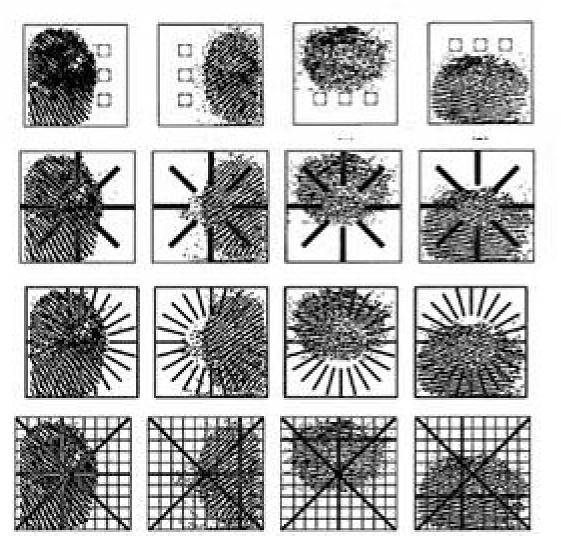

Figure 6: Future considerations for input methods, Samsung Optical Joystick.[13]

ii. Zone and Polygon Systems:

Having surveyed a broad cross section of available input technologies, it is clear that the Xnav and Edgewrite input systems provide the greatest current adaptability for single input text entry. An experimental design in order to test the effectiveness of both systems for glove entry is recommended. Researchers should also consider current work on *menu navigation*, which was not specifically surveyed in this paper. There are a number of applicable studies in this area, notably the work of Shengdong Zhao and his colleagues on Zone and Polygon Menus[35].

iii. Efficiency with balance. Learnability and User Satisfaction in Text Input:

The outstanding work by a number of text entry pioneers have allowed the development of solid metrics for measuring the efficiency of various input methodologies[36][37][38]. Considerations must be made to learnability and a fundamental enjoyment which should be a goal for any input system. Although we may strive for a system which provides a single F.O.A, visual feedback can both aid learnability and enjoyment, as work in the areas of “Kinetic Typography”[39][40], and game-based learning in mobile environments have demonstrated[41]. It is the recommendation of this paper that a prototype feedback system should be developed in order to aid both *adoption* and *learnability* for a zone based system such as xNav.

iv. Converging Fields: Designing for Disabilities and Mobile Device Design.

Surveying current input research reveals much academic motivation is based on designing for users with reduced motor skills. Jacob Wobbrock’s Edgewrite system is a case in point. Clearly designing for disabilities can result in optimal input methodologies for *all* users. Desktop solutions for disabled users have translated well to the mobile device arena. Researchers involved in input methods and feedback systems for mobile devices should seek inspiration in such pan-user goals, and look to draw on the significant amount of current research available[42][43][44].

4. ACKNOWLEDGEMENT

The author would like to acknowledge his colleagues on the “All Mountain GPS device”, which provided the basis for this research: Merideth Stein, Melfa Figueirido and Joanna Seff at DePaul University.

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*This has been developed into an “optical” input for the Samsung SCH V960, available initially for the Korean Market Spring 2007.

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