Pen Computing Now

Pen computing devices have been relegated to the role of name and address organizers due to the difficulty of inputting text quickly and accurately. These devices are highly attractive and hold a great promise that is left largely unfulfilled. If that problem can be overcome, PDAs can become functional enterprise business tools.

Unicode has provided an enterprise caliber character encoding standard that enabled multi-locale support making personal computers into a platform that was capable of significant business work. The other significant piece was efficient networking capability. Sine PDAs have networking capability and support Unicode several of the major components are in place to realize the promise of pervasive devices as real business work tools. Providing the data entry problem can be solved.

The last hurdle is overcoming the text input difficulties for portable devices. Many methods have been proposed for solving the difficulties however most fall short of delivering on the promise of pervasive computing. Pen computing devices have been relegated to the role of name and address organizers due to the difficulty of inputting text quickly and accurately.

These devices are highly attractive and hold a great promise that is left largely unfulfilled. Easy portability and synchronization capabilities with your main computing environment offer the freedom to move through your workday using only this small portable device to take notes and schedule. However the disappointment sets in early...

The difficulties begin with trying to input text into your PDA. The Apple Newton attempted to solve the problem by using word recognition from input cursive text; not very successfully. Processing power was limited and the conversion from scribble to words was slow. Vagaries of handwriting often rendered an incorrect guess. I remember writing the word *marketing* and later looking at the text which had become *make believe*. Text had to be later reviewed for accuracy, much like transcribing notes after a college class.

These problems are related to how Western languages compose words from individual characters that have no intrinsic meaning by themselves. Characters are combined to form words which convey the meaning. Since accurate word recognition is beyond the current capabilities of these devices, we must turn to character entry. Writing character by character while listening or thinking in larger units of information inevitably leaves one lagging way behind.

Gesture recognition which is much simpler to implement and has less chance of error due to the

Graffiti 2
JKLMNOP9R
SHUVWXYZ
0123456789
Done 🗢

more distinct characters was first broadly successful with Graffiti[™]. Learning an abbreviated set of gestures representing individual characters sped input somewhat. Even with macro capabilities and auto word completion functions text input was still cumbersome and slow, requiring the user to focus on the device screen to interact while entering text.

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Miniature keyboards resort defeat the form factor of the PDA. They allow quick entry by a simple and easily understood interface. However the clacking of the keys can be distracting when used in a meeting and are inconvenient to use when drawing your PDA from a pocket to make a quick note.



On-screen tap keyboards are even slower than their real counterparts. All current character input

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methods have real limitations. I know that when in a hurry I resort to the most basic accurate method of input capture; scribble. So input limitations render most pen computers limitedly useful for real use and become mere scribble



recorders.

To enumerate our input problems:

- Processor capability is too limited for accurate transcription of handwriting input on a word by word basis
- Input by character is cumbersome and slow
- Western languages are character based so that we cannot express concepts concisely and quickly with a representative symbol
- We listen, think and write in words and phrases

To fulfill the promise of the PDA we need an input method that is quick, natural and overcomes the limitations of character based input and of limited processing power.

Abandoning Preconceptions

Since most of the failed solutions are focused on character-by-character input methods the shortcomings arise from that. A solution may arise from a different approach.

Most of our input problems are related to how Western languages compose words from individual characters that have no intrinsic meaning by themselves. Individual characters are combined to form words, which convey the meaning.

To enable the PDA to become an effective business tool we need an input method that is quick, natural and overcomes the limitations character based input and of limited processing power. This presentation introduces an alternative input methodology that leverages the standard input keyboard but enables a progression to word entry while being easy to learn, intuitive and natural. QWERsive is an idea that leverages the familiarity of common geographically mapped computer input mechanisms like qwerty-keyboards and the efficiency of stylus-based cursive handwriting. QWERsive may enable this promise of a common input method that supports Unicode and portable text entry in multiple locales.

Let's go back to the origins of human writing systems which were pictographic, so that a character represented an entity. Unlike the glyphs of GraffitiTM these characters are multi-stroke and complex, but we can encapsulate a lot of



information in a single character for economy of expression. The main problem with complex characters for a pen device is stroke order and pen lifting as can be seen in the four strokes composing the simple kanji character for sun.

We have developed an alternative input methodology that leverages the standard input keyboard but enables a progression to word entry while being easy to learn, intuitive and natural.¹

Let's take a standard keyboard in the QWERTY layout, though the invention is applicable to

ab	Q	W	E	R	T	Y	U	ll.	0	P	}	R	
aps	A	S	D	F	FG		J	K	L	Ì:	Ĩ	Enter	
hift		z	x	C	V	в	N	M	<	>	?	Shift	

DVORAK and any foreign language keyboard as well as language. To enter a word the user's stylus is laid upon the first letter of that word. Let's input the word "*the*". The stylus is placed on the character "*t*" slid down right to "*h*" and then up and left to "*e*" then lifted off the keyboard.

In the computer's terms it would be start at a point, move to another point, change line direction and move to another point and end. As a simple

24 35 46 57 68 79 80

implementation we could create an X-Y grid like this illustration. This would enable us to define the gesture for "*the*" as 04, 15, 02.

02 13

This becomes more interesting when in the progression of using the system it becomes apparent that most of these keyboard

gestures are unique. After a short period of practice these gestures become recognizable as unique words and can be entered without tracing over a keyboard map, but as gestures unique unto themselves. This significantly speeds input and also the accuracy of recognition. The QWERsive gestures become a sort of shorthand for quick and accurate entry of whole words.

QWERsive Input

Input as words allow the PDA user to keep a faster entry pace and not fall so far behind as character mode entry. After a short period the user begins to recognize the entry patterns made by the QWERsive entry. While initial input is done with the help of a background map showing the keyboard characters advanced users no longer need the map as the patterns become committed to memory. This allows further forms of entry to be devised. We can move from the touch pad to direct screen entry for touch screen devices. One would no longer need the cumbersome on-screen keyboards to deal with text entry at ATMs or other kiosks. Text entry could be read even off surface by using a camera to interpret the gestures. One could 'signal' a text entry device from across a room.

¹ QWERsive input is not limited to PDA devices, but is adaptable for all computing devices.

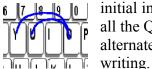
Testing QWERsive

Testing QWERsive against English, the top 500 most frequently used words have unique and individually recognizable patterns. We have devised two testing mechanisms to establish the uniqueness of the QWERsive gestures.

The first test method was to map the pattern of the gesture onto a QWERTY keyboard layout and examine the pattern that emerges. Let us examine some of these patterns; for example the commonly used word 'you' is a simple gesture of a horizontal line starting mid keyboard

flowing to the left by 4 key squares and back to the right 3 key squares. The word is initiated by the touch of the stylus to the registering surface, the lifting of the stylus at the end of the word marks the completion of the word. The letter is registered by a change of the line vector on a key square.

During testing we discovered that we can vary the drawing techniques used for words. In our



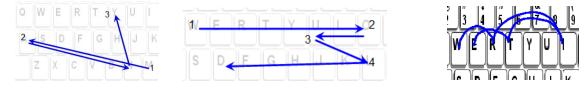
initial implementation we drew straight lines directly between the letters giving all the QWERsive gestures an angular look. Words like "you" led us to an alternate, softer form which is more flowing and curvilinear akin to cursive

The word "have" starts as a horizontal line to the left starting from the mid center of the keyboard extending to the left by five key squares, then diagonally right downwards to just short of center then upward diagonally left, making an extended triangle shape.

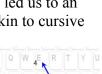
> "About" starts on the middle left of the keyboard extending on a right diagonal downward to the center, diagonally upward right to the top right row and then left to the "u" key square then to the final letter "t". If a letter is in a line, as we see in this example, the vector change can be created by

a making a small loop or a short movement to create the vector change with the stylus that will register the character.

Several other examples of common words are "many", "would" and "write" as depicted below:



Since drawing keymaps was time and labour intensive we invented the second testing method. Recall the previous image of the QWERTY keyboard where we numbered the key positions in a grid; each key has an x and y coordinates assigned. Taking the top 500 words by usage in English we assigned the letters to the matching coordinates. So the coordinates for "you" the numbers would be: 05-08-06; the word "have" is: 15-10-24-02. This table of numbers then can be used to generate the patterns on a display grid.



A recent new testing method is our first live input device, which is an off-the-shelf drawing tablet and stylus and a drawing application with a QWERTY keyboard diagram taped to the input area. This device gives a real feel for how QWERsive works and how quickly one can learn the patterns. This device served to confirm our theories of the utility of the invention.

Unique Patterns and Memory

After a short time of using QWERsive input you begin to develop recognition of the individual shapes of some common words. So those words are now entered without using the keyboard map



but simply entered by shape. "The" was the first word that I began to recognize. Its form is a simple backwards check mark. However its creation was simple and became automatic. Since it is unique the gesture can be created over any part of the keymap grid and recognized by the parser as the gesture for the English word "the". Memory recognition of more unique patterns comes over time.

The keymap is not limited to the US English keyboard layout or to English. All keyboard layouts can be supported in this way. QWERsive patterns start to look something like Asian language ideographs. These symbols had a direct pictographic relationship to the word or concept they represented; now they are more stylized representations that have a mental linguistic meaning without a pictographic link. QWERsive symbols become a shorthand leaned over time and use.

Punctuation and Special Operations

Since QWERsive as we've described it so far is word gesture recognition we need to expand it to add in the other elements that are used in everyday writing. Simple gestures can be used to accomplish this. One scheme is to make use of exit gestures; movement of the stylus out of the keymap area in a specific direction. Punctuation could be at different exits, for example exiting South could terminate a sentence and add a period. Exiting and reentering could add a new paragraph. This method allows many text formatting tasks to be undertaken. Meta keys on the PDA or device could be activated with the user's other hand for more characters or special operations.

Breadth of Use

QWERsive has a broad applicability beyond PDA and pen computers. Any device that requires text input can be adapted to use QWERsive. Any language that can be mapped to a keyboard layout can be supported. Languages that currently use an input method editor (IME) can be shortcut by using a combination of QWERsive entry and a subset of the IME.

QWERsive gestures can be read remotely so that entry can be accomplished for devices that do not have a keyboard or touch screen can be used. The IBM projection keyboard can be much simplified and enhanced using QWERsive entry. QWERsive gestures can also be read from a distance away from the input device using video recognition.

Conclusions

Pen computing devices have been relegated to the role of name and address organizers due to the difficulty of inputting text quickly and accurately. These devices are highly attractive and hold a great promise that is left largely unfulfilled. With Unicode support and networking capability

An Alternative Text Input Method Dustin Kirkland and David Kumhyr, IBM

several of the major steps are in place to realize the promise of pervasive devices as real business work tools.

The last hurdle is overcoming the text input difficulties for portable devices. Many methods have been proposed for solving the difficulties however most fall short of delivering on the promise of pervasive computing.

QWERsive is one solution to fulfill the promise of pen computing. It is an input method that is quick, natural and overcomes the limitations character based input and of limited processing power. This presentation introduces an alternative input methodology that leverages the standard input keyboard but enables a progression to word entry while being easy to learn, intuitive and natural. QWERsive is an idea that leverages the familiarity of common geographically mapped computer input mechanisms like qwerty-keyboards and the efficiency of stylus-based cursive handwriting. QWERsive may enable this promise of a common input method that supports Unicode and portable text entry in multiple locales.

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IBM QWERsive patent application; *System and Method for improved user input on person computing devices*, Dustin Kirkland, David Kumhyr