

USER INTERFACE FOR TEXT INPUT OF COMPOUND CHARACTERS

TECHNICAL FIELD:

5 The exemplary and non-limiting embodiments of this invention relate generally to user devices, such as those used in wireless communication systems, as well as to methods and computer programs and, more specifically, relate to user interfaces to enable text input of languages that use a combination of characters to form compound characters, also known as ligatures or conjunct characters, such as those found in Brahmic scripts.

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BACKGROUND:

This section is intended to provide a background or context to the invention that is recited in the claims. The description herein may include concepts that could be pursued, but are
15 not necessarily ones that have been previously conceived or pursued. Therefore, unless otherwise indicated herein, what is described in this section is not prior art to the description and claims in this application and is not admitted to be prior art by inclusion in this section.

20 The following terms are defined as follows:

Ligature/Conjunct - A letter (character) which is a combination of two or more basic letters. The shape of the ligature or conjunct may, or may not, provide a clue as to the constituent letters. Example: the joint form (diagraph) of " æ".

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Consonant - a speech sound produced by occluding with or without releasing, diverting, or obstructing the flow of air from the lungs. In Latin the letters B C D F G H J K, etc. Note that Character (Char) and consonant are used interchangeably in the following text.

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Halant/Virama - a generic term for a diacritic character in many Brahmic scripts used to suppress an inherent vowel sound that occurs with every consonant character.

Matra/Dependent Vowel - a character associated with a consonant or a character that is applied to a consonant to change the vowel sound of that consonant.

5 Modifier - a mark added to a letter which distinguishes it from the same letter without a mark, usually having a different phonetic value or stress.

Many languages support the formation of ligatures or conjunct characters in some form. Some of these languages may or may not require the use of a special character for joining the two intended characters. The use of the special character results in the formation of
10 the conjunct, where there may or may not be a complete change in the 'glyph' or physical appearance of the resulting conjunct character.

At present, the inventors are not aware of any user interface that provides a truly efficient and user intuitive technique for creating conjunct characters. For example, at times the
15 resultant conjunct character is totally different in appearance, as compared to the participating characters, and the user may tend to think of the ligature as a single character rather than as a combination. One issue that arises is that end users do not necessarily understand the underlying user interface process of using a special character to form a conjunct character.

20 Most of the languages used in the Asia and Pacific (APAC) regions have the characteristic property of supporting the formation of such compound characters, also known as the conjuncts or ligatures. These compound characters are formed by joining two characters using the special character, such as the Halant.

25 Ligature formation has been discussed for Indian languages in Chapter 9 of document: The Unicode Standard 5.0-Electronic Edition, copyright © 1991-2007 Unicode, Inc. Reference can also be made to: Indian Standard, Indian Script Code of Information Interchange-ISCC, © BIS 1991, Bureau of Indian Standards.

30 For example, the Devanagari script employs a sign, referred to as the Halant (Unicode value U+094D), also known as Virama and as a vowel omission sign. The character

Halant (Virama) generally indicates the omission of a vowel sound where it otherwise would occur. Normally, a Halant is used at the end of the word to indicate that the word ends with a consonant sound (thus omitting the inherent vowel). The Indian standard ISCII extends the application of the Halant to indicate the consonant clusters where two or more consonants are to be pronounced without any intervening vowel sound. Visually, such a phenomenon is usually depicted by changing the appearance of the vowel-less consonant, or by replacing a sequence of consonants by a single shape, a ligature. In systems with inadequate means of displaying the consonant clusters, a Halant may be displayed as a visible character to indicate the omission of the vowel sound within the consonant cluster. Figure 1 shows the Halant.

Example:

Character1 + Special Character (Halant) + Character2 = Ligature/Conjunct

In Hindi क + ् + ष = क्‌ष

In Bengali ক + ্ + ড = ক্‌ড

Problems can arise when attempting to implement the creation of conjunct characters, such as when inputting text with the user interface of a small portable device such as a cellular phone. For example, in some cases users may simply not know how to enter a ligature by explicit input of the special character Halant. Further, some users may attempt to enter the ligature straight from a keypad, and may not know how to continue when the needed character is not found. Further problems can arise with those ligatures whose visual appearance differs from the phonation: ক + ্ + ষ = ক্‌ষ. Due to these difficulties some users may avoid the use of 'difficult words' when writing text messages, or if there are words with consonant clusters or ligatures they may be incorrectly written. Some users may also perceive, for example, the ligatures ক্‌ষ or ঞ as independent consonants, and not combinations of two different consonants. This can result in incorrectly writing those words that include such ligatures. Some users may also find it difficult to delete the last participating character of the ligature to form a new ligature.

These various problems may be seen to have a common element related to the fact that users may not be aware of how to create ligatures using the special character (Halant) and as a result they may tend to not use these characters, even though they are an integral part of the language.

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General reference with regard to entering scripts, including APAC scripts, may be found in commonly owned US Patent No.: 6,934,564, issued on August 23, 2005, "Method and Apparatus for Providing Hindi Input to a Device Using a Numeric Keypad", by Petri Laukkanen and Minna-Mari Savolainen.

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SUMMARY

The foregoing and other problems are overcome, and other advantages are realized, by the use of the exemplary embodiments of this invention.

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In a first aspect thereof the exemplary embodiments of this invention provide a method that comprises receiving a first character; receiving a second character; in response to receiving an indication of a drag and drop operation performed on a touch responsive display, superimposing the first character and the second character; and if the first and second characters are suitable for forming a conjunct character, replacing the first and second characters with the conjunct character.

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In another aspect thereof the exemplary embodiments of this invention provide a computer-readable memory medium that stores computer program instructions that when executed result in performing operations that comprise, in response to tactile user input, executing an operation on a touch responsive display so as to at least partially superimpose a first displayed character and a second displayed character; consulting a set of linguistic rules to determine if the superimposed first and second characters are appropriate candidate characters for forming a conjunct character, and if they are, replacing the displayed first and second characters with a displayed conjunct character without requiring user entry of a third, special character.

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In another aspect there is provided an apparatus, comprising: at least one processor; and at least one memory including computer program code the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to perform at least the following: respond to input from a tactile user input device that at least partially superimposes a first displayed character and a second displayed character by consulting a set of linguistic rules to determine if the superimposed first and second characters are appropriate candidate characters for forming a conjunct character, if the determination is affirmative, replace the displayed first and second characters with a displayed conjunct character, without requiring user entry of a third, special character.

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In a further aspect thereof the exemplary embodiments of this invention provide an apparatus that comprises means for entering a first character and a second character; means for displaying the entered first and second characters; means for performing a drag and drop operation so as to superimpose the first character and the second character; means, responsive to detecting the superposition of the first and second characters, for determining if the first and second characters are suitable for forming a conjunct character and, if they are, for replacing the first and second characters with the conjunct character on the display means without requiring entry of a third, special character; and means, responsive to a user touching the same or a different displayed conjunct character and performing a drag operation, for replacing the displayed conjunct character with two constituent characters.

Also disclosed is an apparatus that comprises a controller for coupling with a display and a tactile user input device. The controller is configured so as to respond to input from the tactile user input device, where the input at least partially superimposes a first displayed character and a second displayed character, to consult a set of linguistic rules to determine if the superimposed first and second characters are appropriate candidate characters for forming a conjunct character. The controller is further configured, if the determination is affirmative, to replace the displayed first and second characters with a displayed conjunct character, without requiring user entry of a third, special character.

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BRIEF DESCRIPTION OF THE DRAWINGS

In the attached Drawing Figures:

Figure 1 shows the Halant.

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Figure 2 shows a block diagram of user equipment that is suitable for implementing the exemplary embodiments of this invention.

10 Figures 3A-3H, collectively referred to as Figure 3, show the use of a stylus in conjunction with the touch sensitive display to practice an embodiment of this invention.

Figures 4A-4C, collectively referred to as Figure 4, show the use of fingers in conjunction with the touch sensitive display to practice a gesture-based embodiment of this invention.

15 Figure 5 is a logic flow diagram that illustrates the operation of a method, and a result of execution of computer program instructions embodied on a computer readable memory, for performing conjunct formation in accordance with the exemplary embodiments of this invention.

20 Figure 6 is a logic flow diagram that illustrates the operation of a method, and a result of execution of computer program instructions embodied on a computer readable memory, for performing conjunct separation further in accordance with the exemplary embodiments of this invention.

25 DETAILED DESCRIPTION

The exemplary embodiments of this invention provide an intuitive user interface for text input in any device where the language used for input supports a combination of characters to form a compound character, also known as a ligature or conjunct character.

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The exemplary embodiments of this invention provide a simple and intuitive way of forming and editing conjunct characters without the use of any special characters.

Before describing in detail the exemplary embodiments of this invention, it may be useful to summarize the various problems that can arise when creating ligatures (conjuncts).

- 5 For example, users may not have knowledge of the need to use a special character (for example, the Halant in some of the Indian languages such as Hindi and Bengali) to create the ligature. Further, some users may consider the ligature as a single character. Further, some users may not be able to locate the Halant easily on a device keypad.
- 10 Further, it is noted that the creation of the ligature using conventional input modalities may involve the user having to make a number of key presses. If one takes an example of a ligature formed by two characters, and if one wishes to replace the last character of the ligature with another, this may require at least three key presses.

15 Example:

In Hindi क + ् + ष = क्ष

If one wishes to replace ष with another character, then the following steps may place:

1. क्ष - Press backspace ;
2. Yields क ;
- 20 3. Now insert the needed character after क .

That is, it may require three key presses to form a new ligature from an existing ligature, and at least two key presses to delete the last character in order to be able to create an independent consonant.

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Some currently available methods of ligature creation include the following.

In one case the user first inputs Character1, then explicitly enters the special character Halant, and then enters Character2. As was discussed above, many users may not be

aware that conjuncts are formed by inputting special character. Further, in some cases the physical appearance of the resultant ligature changes its form from the original characters in such a way that the user can have difficulty in identifying the original characters.

- 5 In another case the user may be provided with 'all' possible ligatures readily available on the device so that the user does not have to create them. However, in practice this is not a feasible solution since the numbers of ligatures that can be formed (for example, for some of the Indian languages) is theoretically very large.
- 10 In an attempt to solve the problem of the Halant not being easily discovered by the end user, a short cut method may be used by making the special character available by a press of some predetermined key, e.g., the star (*) key. This may be seen as being essentially the same as requesting the user to enter the special character Halant in some manner. As was discussed above, this may not be a totally satisfactory solution since the user may not
- 15 be capable of finding the short cut to inputting the Halant.

One may also provide direct entry of the most commonly used ligatures. While this approach helps to a certain extent, it is still not completely satisfactory.

- 20 Many conventional techniques of handling ligatures introduce confusion and require multiple key strokes while performing operations such as the complete deletion of a ligature, creating a new ligature by partial modification of an existing ligature, and partial deletion of a ligature to form an independent consonant or character.
- 25 Before describing in further detail the exemplary embodiments of this invention, reference is made to Figure 2 for illustrating a user device or user equipment (UE) 10 in both plan view (left) and sectional view (right). The exemplary embodiments of this invention may be embodied in one or some combination of function-specific components.
- 30 In Figure 2 the UE 10 has a graphical display interface 20 and a user interface 22 illustrated as a keypad but understood as also encompassing touch-screen technology at the graphical display interface 20 as well as voice-recognition technology received at a

microphone 24. A power actuator 26 controls the device being turned on and off by the user. The exemplary UE 10 may have a camera 28 which is shown as being forward facing (e.g., for video calls) but may alternatively or additionally be rearward facing (e.g., for capturing images and video for local storage). The camera 28 is controlled by a shutter actuator 30 and optionally by a zoom actuator 32 which may alternatively function as a volume adjustment for the speaker(s) 34 when the camera 28 is not in an active mode.

Within the sectional view of Figure 2 are seen multiple transmit/receive antennas 36 that are typically used for cellular communication. The antennas 36 may be multi-band for use with other radios in the UE. The operable ground plane for the antennas 36 is shown by shading as spanning the entire space enclosed by the UE housing though in some embodiments the ground plane may be limited to a smaller area, such as disposed on a printed wiring board on which the power chip 38 is formed. The power chip 38 controls power amplification on the channels being transmitted and/or across the antennas that transmit simultaneously where spatial diversity is used, and amplifies the received signals. The power chip 38 outputs the amplified received signal to the radio-frequency (RF) chip 40 which demodulates and downconverts the signal for baseband processing. The baseband (BB) chip 42 detects the signal which is then converted to a bit-stream and finally decoded. Similar processing occurs in reverse for signals generated in the apparatus 10 and transmitted from it.

Signals to and from the camera 28 may pass through an image/video processor 44 which encodes and decodes the various image frames. A separate audio processor 46 may also be present controlling signals to and from the speakers 34 and the microphone 24. The graphical display interface 20 is refreshed from a frame memory 48 as controlled by a user interface chip 50 which may process signals to and from the display interface 20 and/or additionally process user inputs from the keypad 22 and elsewhere.

Certain embodiments of the UE 10 may also include one or more secondary radios such as a wireless local area network radio WLAN 37 and a Bluetooth® radio 39, which may incorporate an antenna on-chip or be coupled to an off-chip antenna. Throughout the

apparatus are various memories such as random access memory RAM 43, read only memory ROM 45, and in some embodiments there may be removable memory such as the illustrated memory card 47. Various programs are stored in one or more of these memories. All of these components within the UE 10 are normally powered by a portable
5 power supply such as a battery 49.

The aforesaid processors 38, 40, 42, 44, 46, 50, if embodied as separate entities in a UE 10, may operate in a slave relationship to the main processor 10A, 12A, which may then be in a master relationship to them. Embodiments of this invention are relevant at least
10 to the user interface, including the user input and user output display functionality of the UE 10 embodied in the touch sensitive display interface 20 and the UI/display chip 50. In certain embodiments the exemplary embodiments may be disposed across various chips and memories or disposed within another processor that combines some of the functions described above for Figure 2. Any or all of these various processors of Figure 2 access
15 one or more of the various memories, which may be on-chip with the processor or separate therefrom.

Note that the various chips (e.g., 38, 40, 42, 50, etc.) that were described above may be combined into a fewer number than described and, in a most compact case, may all be
20 embodied physically within a single chip.

Note further that while Figure 2 shows the UE 10 as having wireless communication capabilities, the exemplary embodiments of this invention may be practiced in a device having no wireless communication capabilities, or in a device having only wired
25 communication capabilities (e.g., via an electrical or optical cable or other wiring). In general, the exemplary embodiments of this invention may be practiced in a device that simply enables user text entry for whatever purpose.

As was discussed previously, in the previous approaches to forming the conjunct
30 character the user is expected to input the Halant explicitly or implicitly between the two characters to create the conjunct.

The exemplary embodiments of this invention provide techniques that make it possible to create a ligature by drag-dropping one character on top of the other, or by using gestures on a touch sensitive surface of a device, thereby eliminating the need for the use of the Halant. As non-limiting examples, it is possible to use either a finger or a stylus, or any
5 similar object, to create a ligature.

The exemplary embodiments of the invention provide a technique to form the ligature or conjunct character using gestures, as well as a technique to separate the individual characters from the conjunct using gestures.

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Reference is now made to Figures 3A-3H, collectively referred to as Figure 3, that show the use of a stylus 20A in conjunction with the touch sensitive display 20 to practice an embodiment of this invention.

15 In Figure 3A the user enters a first character (Character1), such as by using the stylus 20A. In Figure 3B the user enters a second character (Character2), such as by using the stylus 20A.

Note that character entry may be part of a handwriting recognition function executed by
20 the device 10, although the exemplary embodiments of this invention are not constrained with regard to how Character1 and Character2 are entered. For example, they may be entered directly by the user via a keypad or keyboard, or by a voice recognition system, or by any suitable means, including receipt of the characters from a communication channel.

25 In Figure 3C the user highlights (places focus on) Character2, such as by tracing around Character2 with the tip of the stylus 20A. In Figure 3D the user drags the highlighted Character2 so that it at least partially overlies Character1 (is at least partially superimposed upon Character1), and then drops it such as by lifting the tip of the stylus 20A or by providing an explicit drop signal. Figure 3E shows the result of the operations
30 depicted in Figures 3A-3D, i.e., the created conjunct character. Notice that the conjunct character was created by the user without requiring the user to locate and/or input the Halant character.

It should be noted that the sequence or order of input of characters on the user interface should be considered, in particular, the order of the constituent characters as they were written on the interface before either of them were moved (dragged/or pinched) is of
5 concern when creating the conjunct character. Grammatically, for example, $A+B = X$ while $B+A=Z$.

As such,

Case 1: if grammatically $\text{char1} + \text{char 2} = \text{conjunct x}$,

10 **Case 2:** while grammatically $\text{char 2} + \text{char 1} = \text{conjunct y}$,
then in case 1 dropping/dragging char 2 on char 1 (i.e., "drag left") will create conjunct X.
That is, before having started the gesture of dragging/dropping the order of the characters was Char 1 preceding Char 2 on the display 20, that ordering defines the rule of conjunct creation.

15 Similarly in case 2 dragging/dropping char 2 on char 1 will create conjunct Y and not conjunct X, even though in both case 1 and 2 the char 2 is being dropped on char 1.

In summary, the order of the constituent characters before the gesture begins determines
20 the identity of the resultant conjunct.

Figures 3F, 3G and 3H illustrate a further aspect of the embodiments of this invention which pertain to separation of a conjunct character. In Figure 3F the user highlights all or at least a part of a conjunct character (for simplicity, the same character created in Figure
25 3E). In Figure 3G the user employs the tip of the stylus 20A to drag away the highlighted portion of the conjunct character. Figure 3H shows the end result, i.e., the conjunct character is separated into its constituent characters (for example, Character1 and Character2 as in Figures 3A and 3B, respectively).

30 Figures 4A-4C, collectively referred to as Figure 4, show the use of fingers 20B, 20C in conjunction with the touch sensitive display 20 to practice a gesture-based embodiment of this invention.

Figure 4A assumes the presence on the display 20 of two characters, Character1 and Character2. The user touches the surface of the touch sensitive display 20 over Character1 and Character2 with the tips of two fingers 20B, 20C, and then draws the two
5 finger tips together (pinches in the two characters) as depicted by the arrows A. Figure 4B shows the result, i.e., the creation of the conjunct character from Character1 and Character2. Figure 4C assumes the presence on the display 20 of the conjunct character, such as the one created from Character1 and Character2 in Figures 4A and 4B. The user touches the surface of the touch sensitive display 20 over the conjunct character with the
10 tips of the two fingers 20B, 20C, and then pulls the two finger tips apart as depicted by the arrows B. Figure 4C shows the result, i.e., the separation of the conjunct character into the two constituent characters, Character1 and Character2.

It should be appreciated that the use of these exemplary embodiments of the invention
15 removes the need for explicit use of a special character (e.g., the Halant) to form the conjunct character, and furthermore provides a simple and intuitive method for the user to create the conjunct character, thereby increasing the usage of conjunct characters when entering text. Furthermore, the separation of the participating characters, while editing or ligature formation, is greatly facilitated, thereby reducing the number of clicks and overall
20 complexity.

Reference is now made to Figure 5 for showing in logic flow diagram form one possible embodiment of algorithms for implementing the conjunct character creation shown in Figure 3. Note that the names of the algorithms used in Figure 5 (and also Figure 6
25 described below) are provided only to facilitate an understanding of the invention, as the selected names provide enhanced clarity as to the overall purpose and functionality of the algorithm. As such, the particular algorithm names used in Figures 5 and 6 are not intended to be limiting in any respect as to how the exemplary embodiments of this invention are implemented in any particular instantiation thereof.

30

Block 5A:

OnClickChar

This algorithm is called when the system determines there is a touch event on a particular character on the display screen 20.

Block 5B:

5 **IsTouchEventValid**

This algorithm determines if the relative position of two characters have been reduced. Valid Events can be, for example, Pinch, Drag.

10 If the EventType is determined to be invalid, control passes to Block 5C and the invalid event is handled in an appropriate manner. If the EventType is determined to be valid, control passes to Block 5D.

Block 5D:

CharOnChar

15 This algorithm is called when the system determines that a character is being superimposed on another character.

Block 5E:

IsOverlapAreaOk

20 This algorithm is also called when the system determines a character is being superimposed on another character, and operates with a function (Block 5F) that may be referred to as **OptimumOverlapAreaDefn**. This function creates a definition as to how much overlap area is needed for the system to consider the character superimposition sufficient for conjunct formation. Based on the determination made at Block 5E there is
25 either a sufficient overlap area present or there is not. If not, control passes to Block 5G to return back to the calling function. If a sufficient amount of overlap area is found to be present, control instead passes to Block 5H.

Block 5H:

30 **IsItOkToFormConjunct**

This function examines the linguistic rules of the language, assumed to be stored in a memory of the device 10, to determine if it is feasible to form a conjunct character from

the characters supplied (and that are considered to be overlapped (superimposed) on the display screen 20). If the determination is negative, i.e., the two characters are not appropriate for forming a conjunct character according to the linguistic rules of the language of interest, then control passes to Block 5G to return back to the calling function. If the determination is positive, i.e., the two characters are appropriate for forming a conjunct character according to the linguistic rules of the language of interest, then control passes instead to Block 5I.

10 Block 5I:

This step forms the conjunct character and presents it on the display 20, as depicted in Figures 3E and 4B. That is, the two superimposed characters are replaced with an image of the desired conjunct character, which may then also be stored in an input text buffer of the UE 10.

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Reference is now made to Figure 6 for showing in logic flow diagram form one possible embodiment of algorithms for implementing the conjunct character separation shown in Figure 4.

20 Block 6A:

OnClickConjunctChar

This algorithm is called when the system determines that there is a touch event on a conjunct character.

25 Block 6B:

IsTouchEventValid

This algorithm determines if the relative position of two characters have increased. Valid Events (for example) may be Pinch, Drag, while Invalid Events may be, for example, Tap. If the EventType is determined to be invalid the invalid event is handled in an appropriate manner. If the EventType is determined to be valid, control passes to Block 6C.

Block 6C:

DetermineConjunctType

Visually there are multiple possibilities when the conjunct combines with Matras and Modifiers. The purpose of this algorithm is to categorize what kind of Conjunct is present
5 and to return the category. This algorithm operates with a ConjunctType function at Block 6D. Examples of conjunct categories may include, as non-limiting examples:

Case1: Conjunct = Char + Char

Case2: Conjunct = Matra + Char + Char

10 Case3: Conjunct = Char + Char + Matra

Case4: Conjunct = Char + Char + Matra + Modifier

Case5: Conjunct = Matra +Char + Char + Modifier

Case 6: Complex Conjunct = Char + Conjunct.

15 After the Conjunct Type has been correctly categorized, control passes to Block 6E.

Block 6E:

DetermineCharForSeparation

Depending on the category of the conjunct, this algorithm divides the characters into
20 separable character clusters. This algorithm operates with a Separable Character Clusters function shown in Block 6F. Examples of separable character clusters may include, as non-limiting examples:

Case1: Char and Char

25 Case2: Matra + Char and Char

Case3: Char and Char + Matra

Case4: Char and Char + Matra + Modifier

Case5: Matra +Char and Char + Modifier

Case 6: Complex Conjunct = Char + Conjunct.

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Having determined an appropriate separable character cluster, control passes to Block 6G.

Block 6G:

SeparateConjunctChars

This algorithm physically separates the characters participating in the conjunct formation.

5 Control then passes to Block 6H.

Block 6H:

This step forms the separated characters and presents them on the display 20, as depicted in Figures 3H and 4C. That is, the image of the conjunct character on the display 20 is
10 replaced with images of the two constituent characters, and the representation of the conjunct character in the text buffer is replaced with representations of the two constituent characters.

Note that having thus separated the conjunct character, one of the constituent characters
15 (e.g., Character2) may be erased and then replaced with another character (Character3) which may also be appropriate for forming a conjunct character with the other, remaining character (Character1), and the method of Figure 5 may be executed to form a new conjunct character from Character1 and Character3.

20 The various blocks shown in Figures 5 and 6 may be viewed as method steps, and/or as operations that result from operation of computer program code, and/or as a plurality of coupled logic circuit elements constructed to carry out the associated function(s). Further, certain ones of the various steps may be executed in some cases in other than the order depicted, and additional steps may be included if desired.

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In general, the various exemplary embodiments may be implemented in hardware or special purpose circuits, software, logic or any combination thereof. For example, some aspects may be implemented in hardware, while other aspects may be implemented in firmware or software which may be executed by a controller, microprocessor or other
30 computing device, although the invention is not limited thereto. While various aspects of the exemplary embodiments of this invention may be illustrated and described as block diagrams, flow charts, or using some other pictorial representation, it is well understood

that these blocks, apparatus, systems, techniques or methods described herein may be implemented in, as nonlimiting examples, hardware, software, firmware, special purpose circuits or logic, general purpose hardware or controller or other computing devices, or some combination thereof.

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It should thus be appreciated that at least some aspects of the exemplary embodiments of the inventions may be practiced in various components such as integrated circuit chips and modules, and that the exemplary embodiments of this invention may be realized in an apparatus that is embodied as an integrated circuit. The integrated circuit, or circuits,
10 may comprise circuitry (as well as possibly firmware) for embodying at least one or more of a data processor or data processors, a digital signal processor or processors, baseband circuitry and radio frequency circuitry (if present) that are configurable so as to operate in accordance with the exemplary embodiments of this invention.

15 Various modifications and adaptations to the foregoing exemplary embodiments of this invention may become apparent to those skilled in the relevant arts in view of the foregoing description, when read in conjunction with the accompanying drawings. However, any and all modifications will still fall within the scope of the non-limiting and exemplary embodiments of this invention.

20

For example, while described primarily in the context of Brahmic languages that utilize the Halant, these exemplary embodiments may be used with other languages that provide for the formation of conjunct characters.

25 Further by example, while described above in the context of a tactile input display device that is touched by the user with an object held by the user, such as a stylus, or that is touched by the user's finger or fingers, these exemplary embodiments may also be practiced with a display system that does not require a physical touching, such as one that is capable of detecting the proximity in three dimensional space of the object/finger(s).
30 That is, these exemplary embodiments may also be embodied in a system that uses, for example, light or sound to detect a presence of an object, and the movement of the object in three dimensional space, and may also be implemented with a projection type of

display system. For the purposes of describing this invention all such types of input means may be considered as "tactile" input means, and the act of "touching" a display should be understood to encompass both physical touching and virtual touching.

5 It should be noted that the terms "connected," "coupled," or any variant thereof, mean any connection or coupling, either direct or indirect, between two or more elements, and may encompass the presence of one or more intermediate elements between two elements that are "connected" or "coupled" together. The coupling or connection between the elements can be physical, logical, or a combination thereof. As employed herein two elements may
10 be considered to be "connected" or "coupled" together by the use of one or more wires, cables and/or printed electrical connections, as well as by the use of electromagnetic energy, such as electromagnetic energy having wavelengths in the radio frequency region, the microwave region and the optical (both visible and invisible) region, as several non-limiting and non-exhaustive examples.

15 Furthermore, some of the features of the various non-limiting and exemplary embodiments of this invention may be used to advantage without the corresponding use of other features. As such, the foregoing description should be considered as merely illustrative of the principles, teachings and exemplary embodiments of this invention, and
20 not in limitation thereof.

CLAIMS

What is claimed is:

1. A method, comprising:
5 receiving a first character;

receiving a second character;

10 in response to receiving an indication of a drag and drop operation performed on a touch responsive display, superimposing the first character and the second character; and

if the first character and the second character are suitable for forming a conjunct character, replacing the first character and the second character with the conjunct
15 character.
2. The method of claim 1, where the step of replacing is performed without requiring receipt of a third, special character.
- 20 3. The method as in either claim 1 or claim 2, where receipt of the drag and drop operation is in response to use of an object held by a user that is touched to the touch responsive display.
4. The method as in either claim 1 or claim 2, where receipt of the drag and drop
25 operation is in response to at least one finger of a user that is touched to the touch responsive display.
5. The method of claim 4, where the first and second characters are superimposed in response to the user simultaneously touching the first and second characters with first and
30 second fingertips, and drawing the first and second fingertips together in a pinching gesture.

6. The method as in any one of the previous claims, further comprising:

in response receiving the user touching a displayed conjunct character and performing a drag operation on the touch responsive display, replacing the displayed conjunct character
5 with two constituent characters.

7. A computer-readable memory medium that stores computer program instructions that when executed result in performing operations that comprise:

10 in response to tactile user input, executing an operation on a touch responsive display so as to at least partially superimpose a first displayed character and a second displayed character;

consulting a set of linguistic rules to determine if the superimposed first and second
15 characters are appropriate candidate characters for forming a conjunct character, and

if they are, replacing the displayed first and second characters with a displayed conjunct character without requiring user entry of a third, special character.

20 8. The computer-readable memory medium as in claim 7, where the tactile user input is provided by an object held by the user or by at least one of the user's fingers.

9. The computer-readable memory medium as in claim 7, where the tactile user input is provided by the user simultaneously touching the first and second displayed characters
25 with first and second fingertips, and drawing the first and second fingertips together in a pinching gesture.

10. The computer-readable memory medium as in any one of the previous claims, further comprising an operation of:

30 in response to the user touching a displayed conjunct character and performing drag operation on the touch responsive display, replacing the displayed conjunct character with

two constituent characters.

11. The computer-readable memory medium as in any one of the previous claims, embodied within a portable user device with said touch responsive display.

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12. An apparatus, comprising:

at least one processor; and

at least one memory including computer program code

the at least one memory and the computer program code configured to, with the at least

10 one processor, cause the apparatus to perform at least the following:

respond to input from a tactile user input device that at least partially superimposes a first displayed character and a second displayed character by consulting a set of linguistic rules to determine if the superimposed first and second characters are appropriate candidate characters for forming a conjunct character,

15 if the determination is affirmative, replace the displayed first and second characters with a displayed conjunct character, without requiring user entry of a third, special character.

13. The apparatus as in claim 12, where said tactile user input device is a touch sensitive
20 display, upon which the first, second, and conjunct characters are displayed.

14. The apparatus as in either claim 12 or 13, where the tactile user input device is responsive to an object held by a user or to at least one of the user's fingers.

25 15. The apparatus as in any one of the previous claims, said controller being further configured to respond to a user touching a displayed conjunct character and performing a drag operation to replace the displayed conjunct character with two constituent characters.

30 16. The apparatus as in any one of the previous claims, embodied as a portable user device.

17. The apparatus as in any one of the previous claims, embodied as a portable wireless communication device.

18. The apparatus as in any preceding claim, where the special character is a diacritic
5 character used to suppress an inherent vowel sound that occurs with a consonant character.

19. An apparatus, comprising:

10 means for entering a first character and a second character;

means for displaying the entered first and second characters;

means for performing a drag and drop operation so as to superimpose the first character
15 and the second character;

means, responsive to detecting the superposition of the first and second characters, for
determining if the first and second characters are suitable for forming a conjunct
character and, if they are, for replacing the first and second characters with the conjunct
20 character on said display means without requiring entry of a third, special character; and

means, responsive to a user touching the same or a different displayed conjunct character
and performing a drag operation, for replacing the displayed conjunct character with two
constituent characters.

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20. The apparatus as in claim 19, embodied as at least one integrated circuit in a portable device.