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(54) **VIRTUAL KEYPAD SYSTEMS AND METHODS**

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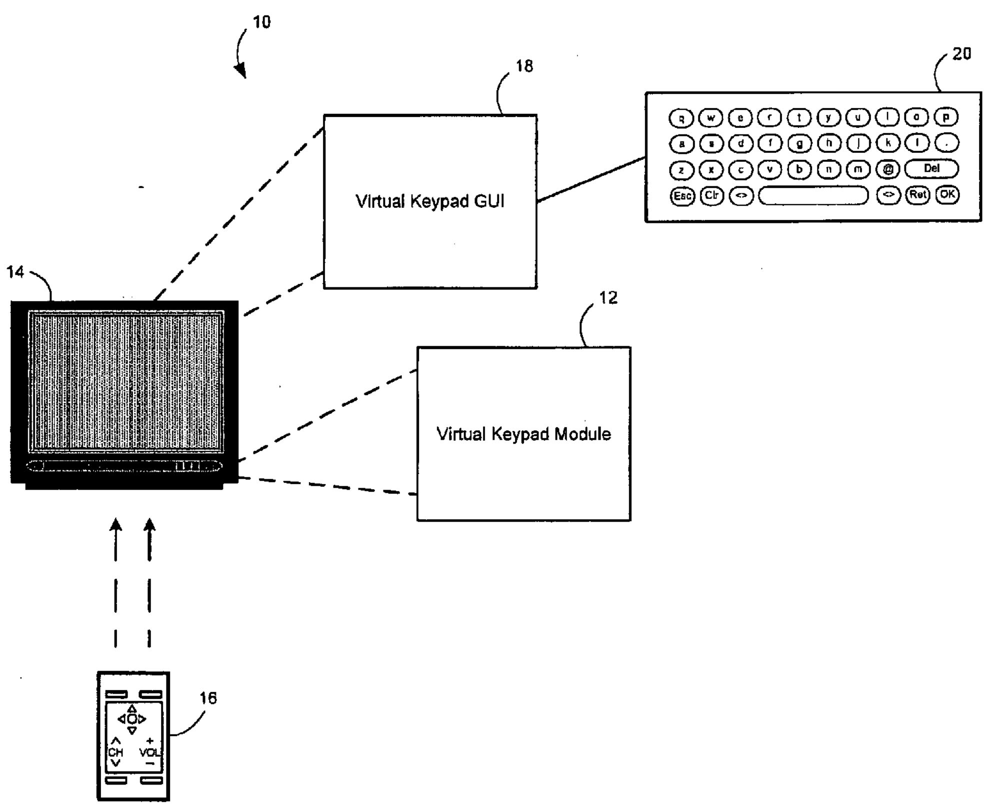
(57) **ABSTRACT**

Accordingly, a virtual keypad system for inputting text is provided. A virtual keypad system includes a remote controller having at least one touchpad incorporated therein and divided into a plurality of touch zones. A display device is in data communication with the remote controller and is operable to display a user interface including a keypad, where each key of the keypad is mapped to a touch zone of the touchpad. A prediction module, in response to an operator pressing a given touch zone to select a particular character, performs one or more key prediction methods to predict one or more next plausible keys. A key mapping module remaps the touch zones of the touchpad to the keys of the keypad based on the one or more next plausible keys.



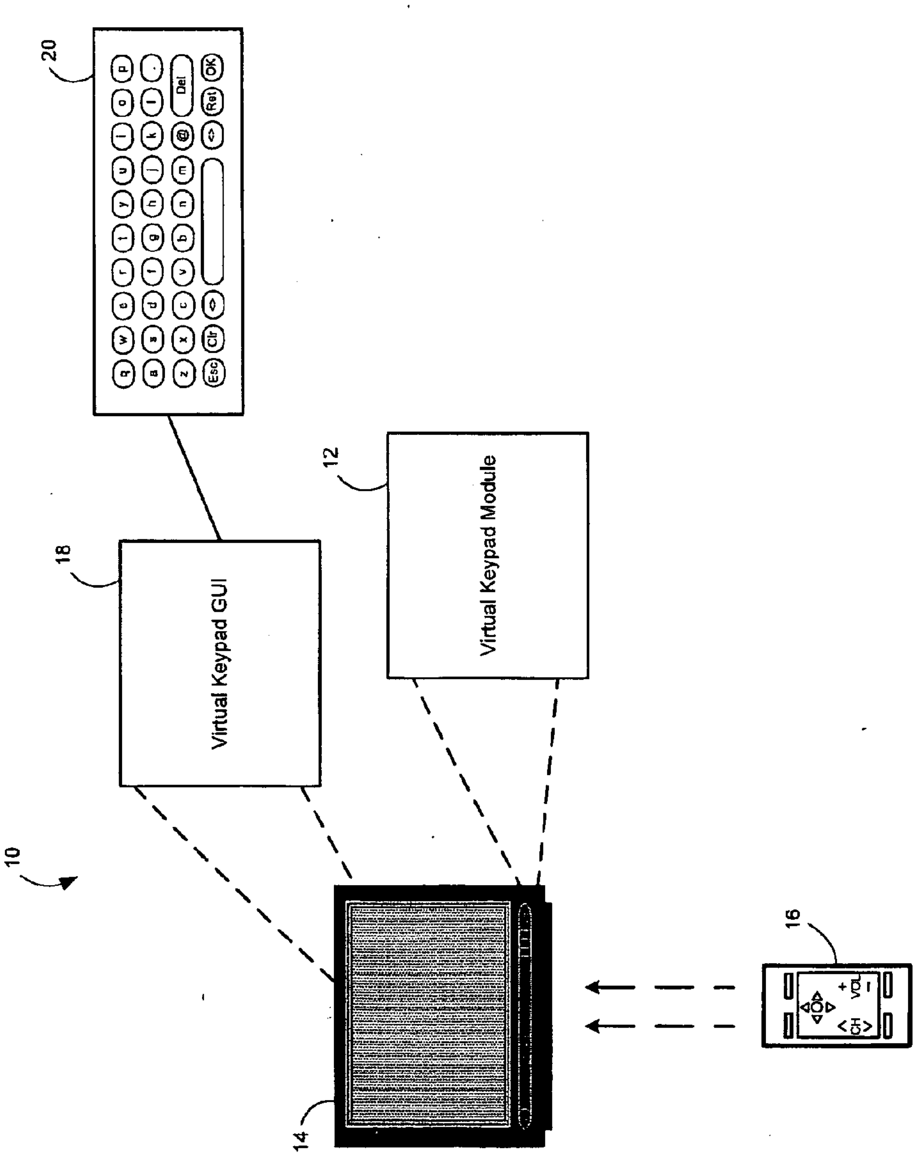


Figure 1

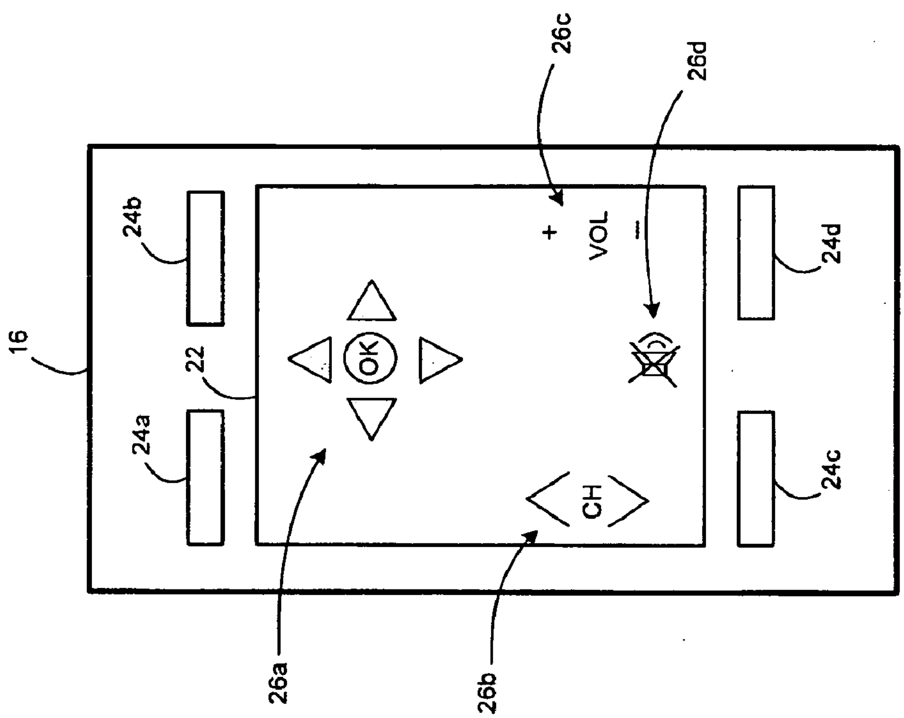


Figure 2A

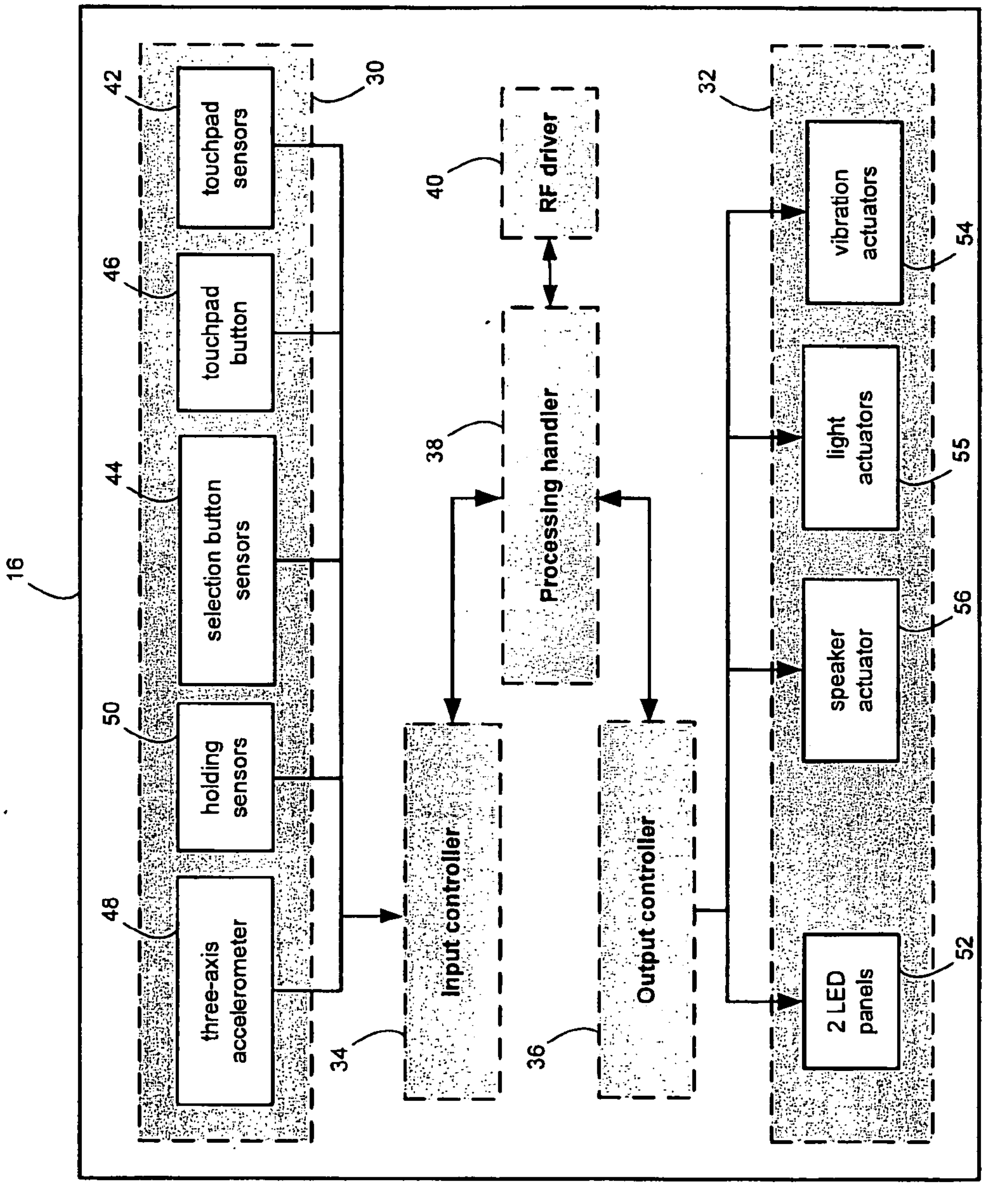

16
30
42
touchpad sensors
46
touchpad button
44
selection button sensors
50
holding sensors
48
three-axis accelerometer
40
RF driver
38
Processing handler
34
Input controller
36
Output controller
32
vibration actuators
54
light actuators
55
speaker actuator
56
2 LED panels
52

Figure 2B

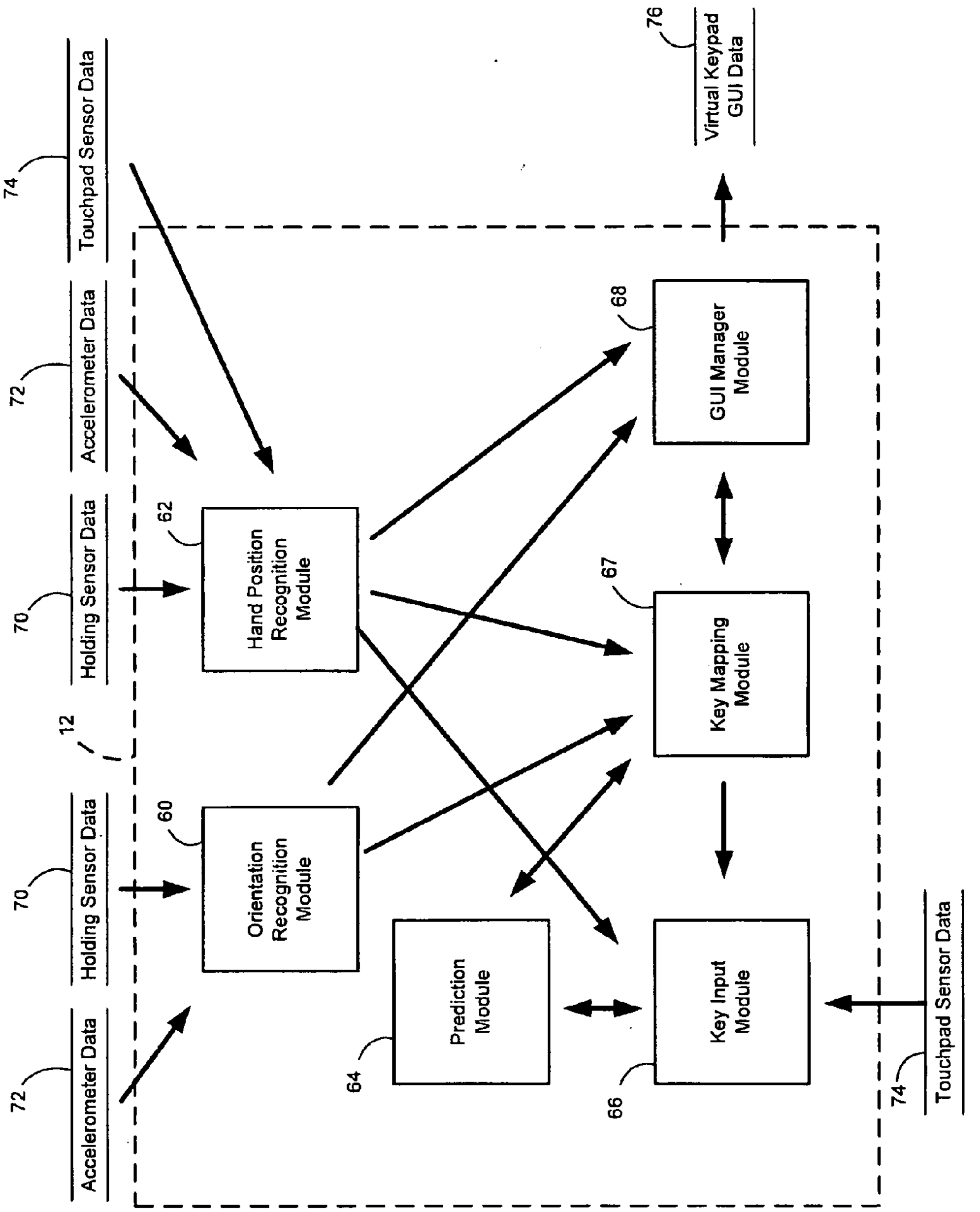

Accelerometer Data
72
Holding Sensor Data
70
Holding Sensor Data
70
Accelerometer Data
72
Touchpad Sensor Data
74
12
Orientation Recognition Module
60
Hand Position Recognition Module
62
Prediction Module
64
Key Input Module
66
Key Mapping Module
67
GUI Manager Module
68
Virtual Keypad GUI Data
76
Touchpad Sensor Data
74

Figure 3

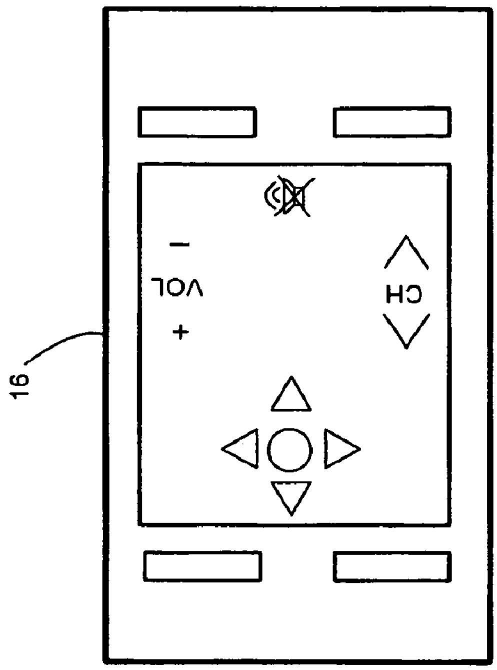


Figure 4B

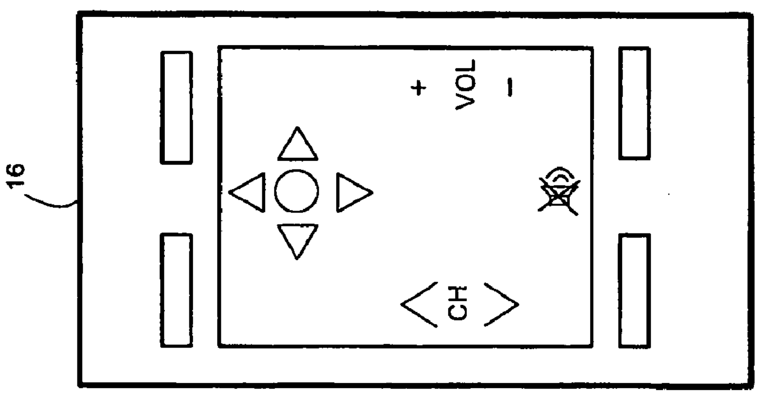


Figure 4A

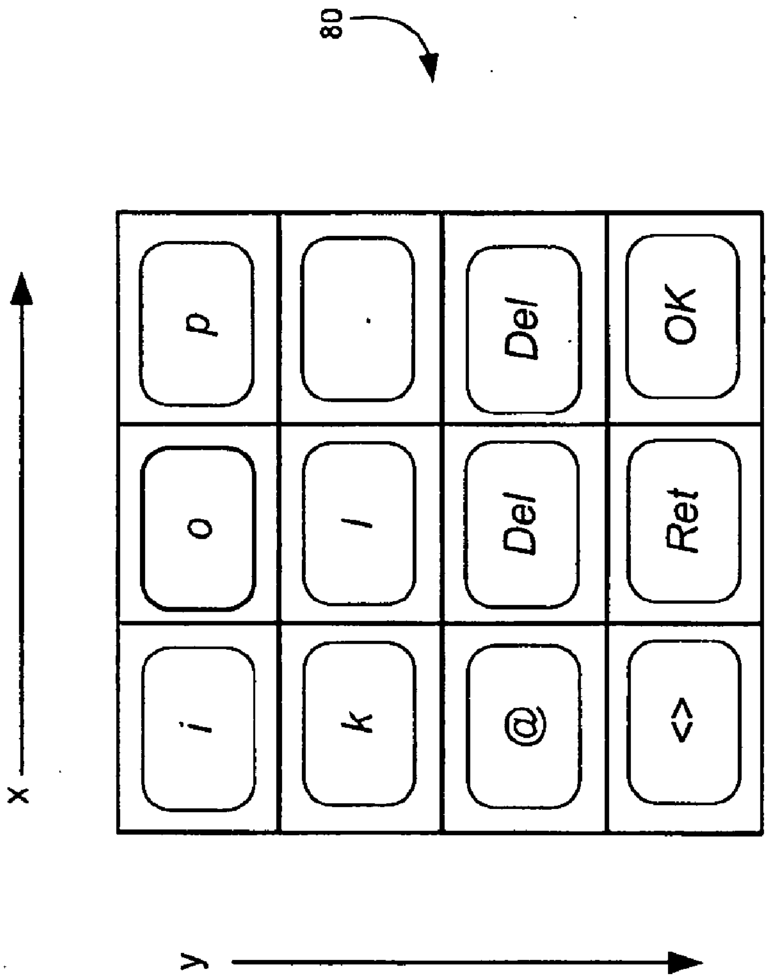


Figure 5

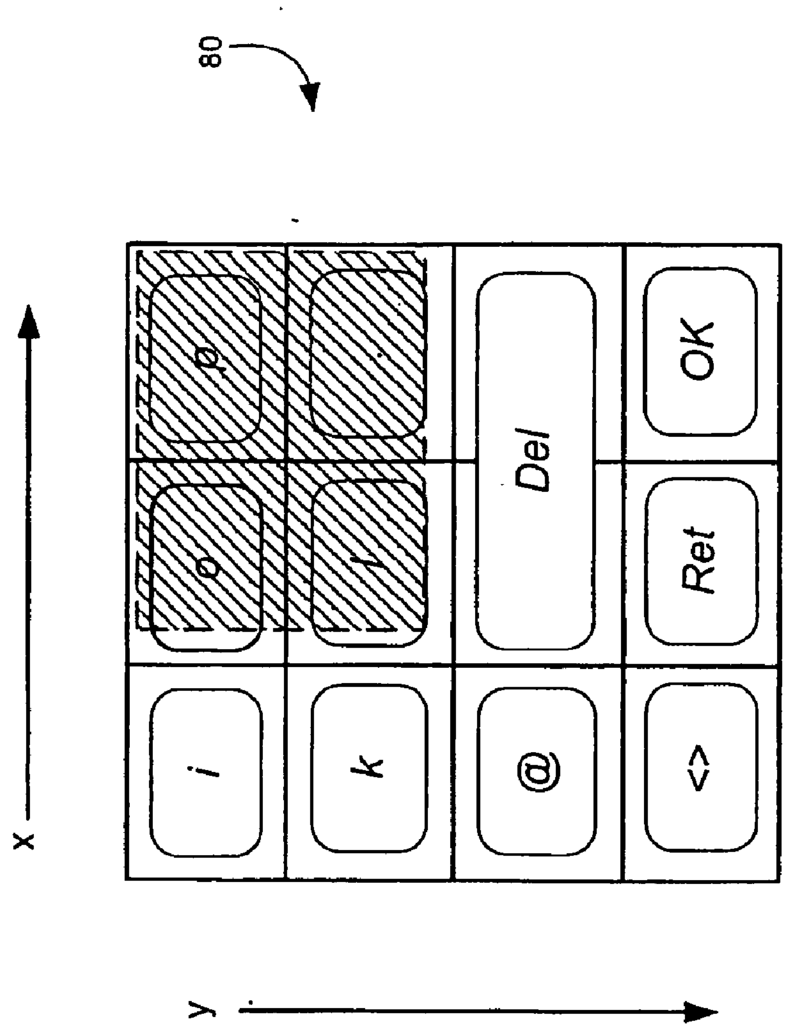
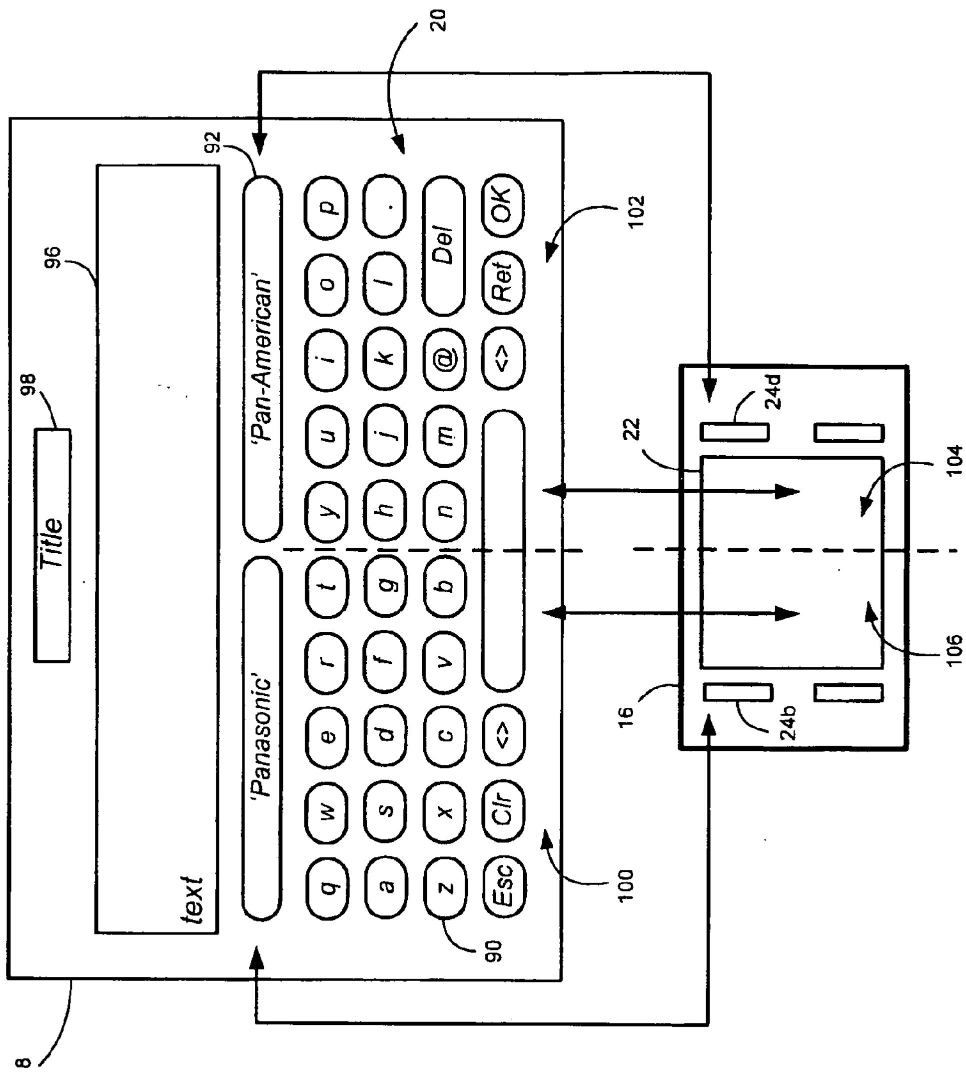
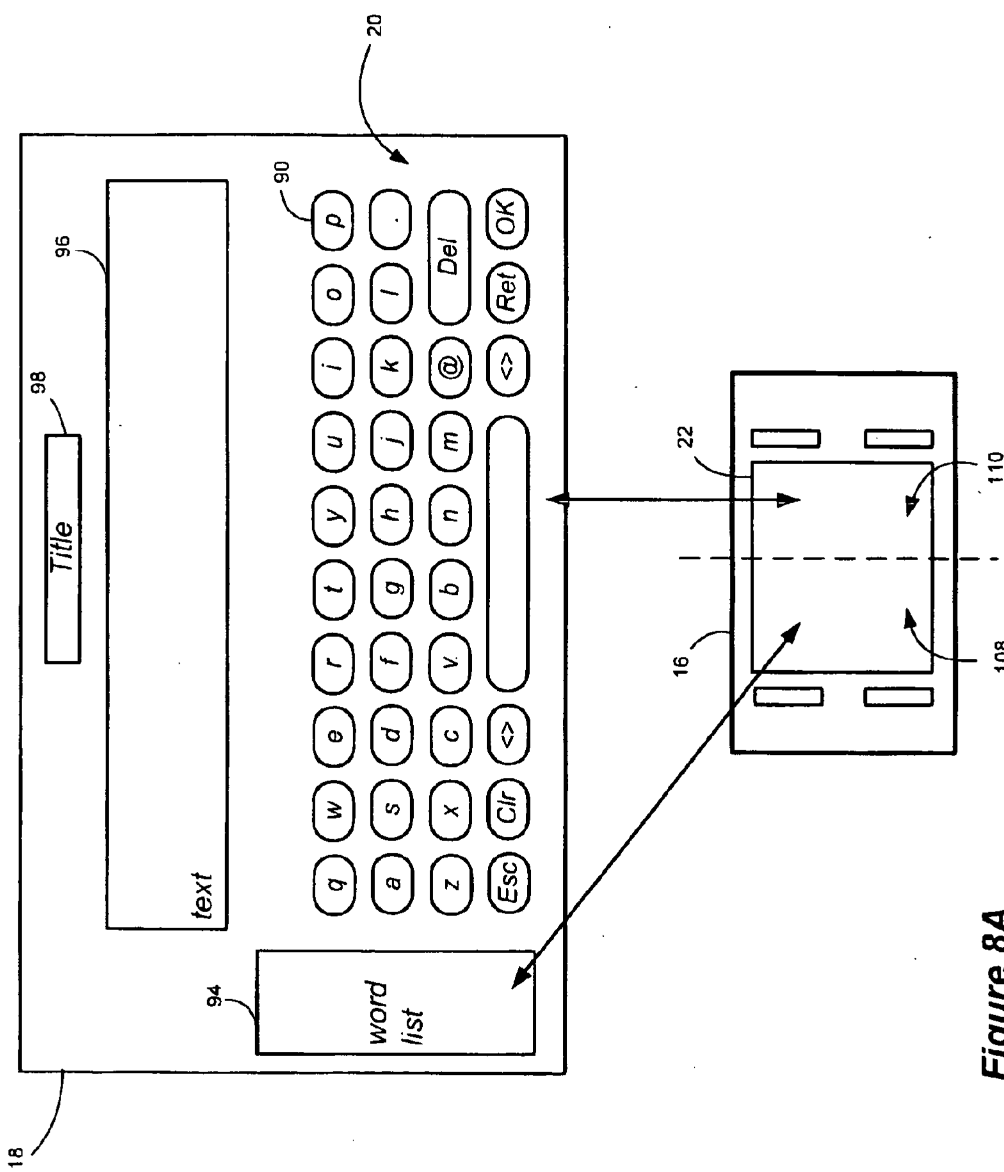


Figure 6



18
96
98
Title
text
92
20
'Panasonic'
'Pan-American'
q w e r t y u i o p
a s d f g h j k l .
z x c v b n m @ Del
Esc Clr <> <> Ret OK
90
100
102
22
24d
24b
104
106
16

Figure 7


20
90
96
98
Title
text
word
list
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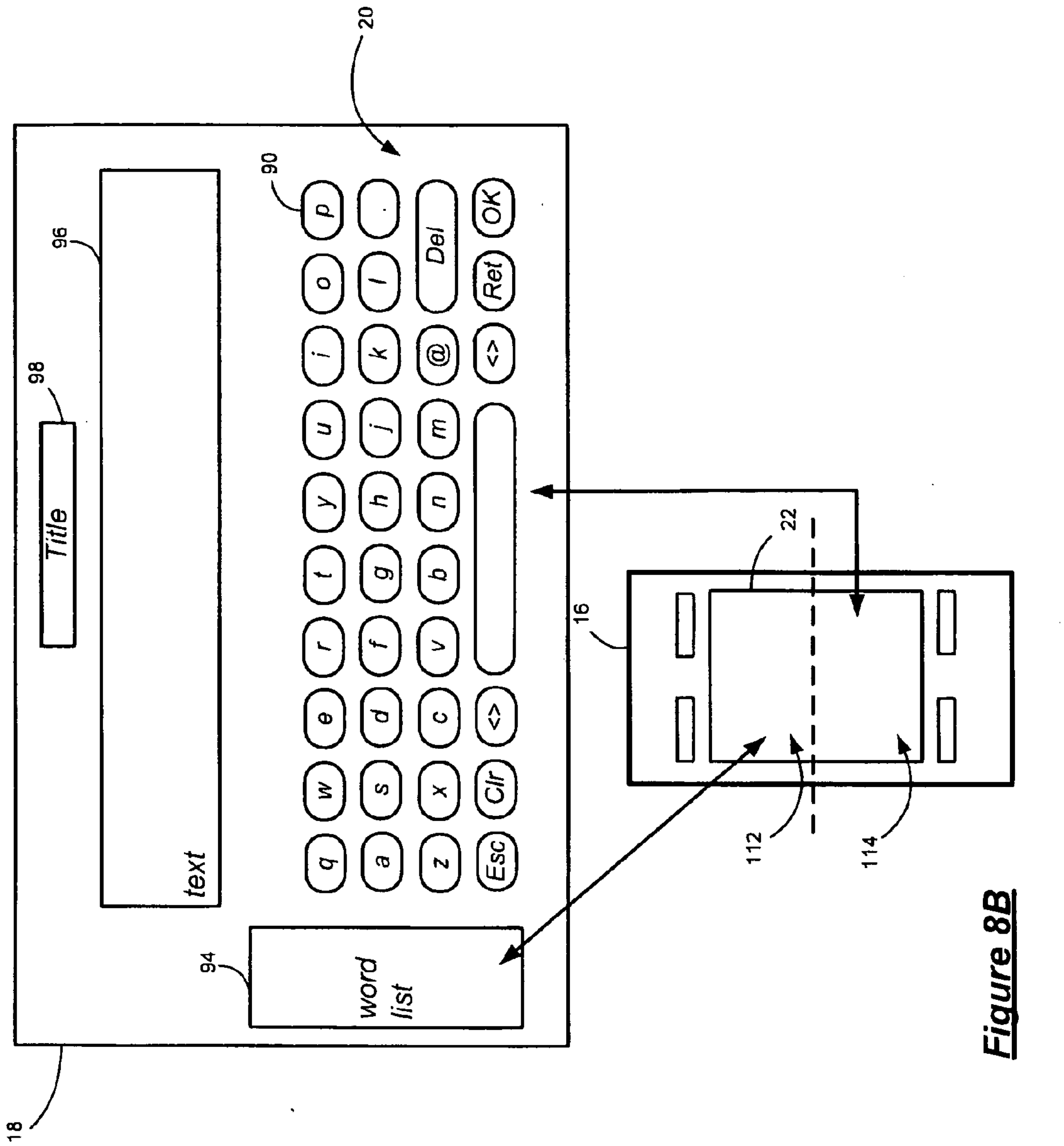
18
22
110
16
108
q w e r t y u i o p
a s d f g h j k l .
z x c v b n m @ Del
Esc Clr <> <> Ret OK

Figure 8A


20
90
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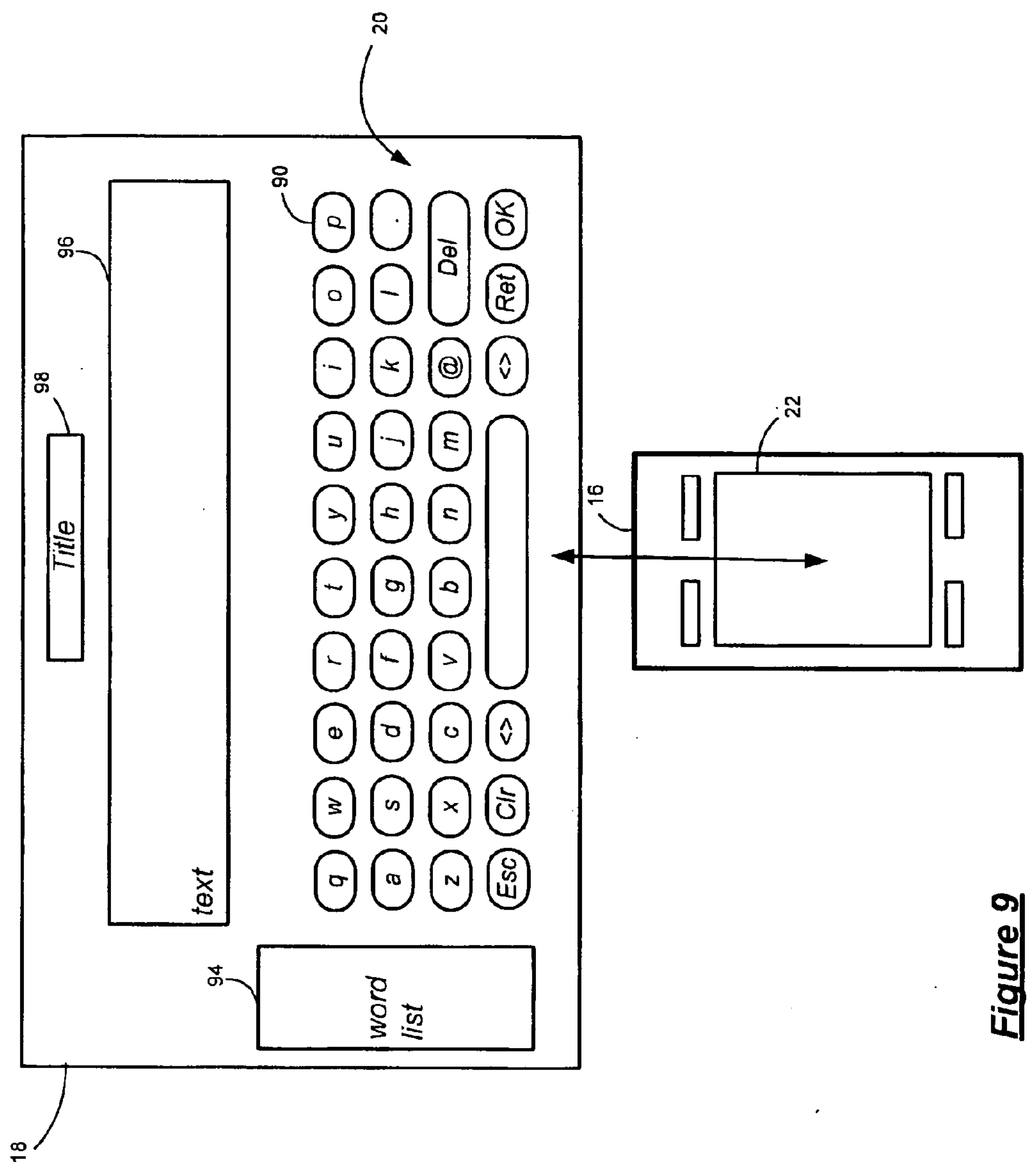
98
Title
text
word list
q w e r t y u i o p
a s d f g h j k l .
z x c v b n m @ Del
Esc Clr <> <> Ret OK
94
18
16
22
112
114

Figure 8B


20
18
98
Title
96
text
94
word list
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a s d f g h j k l .
z x c v b n m @ Del
Esc Clr <> <> Ret OK
16
22

Figure 9

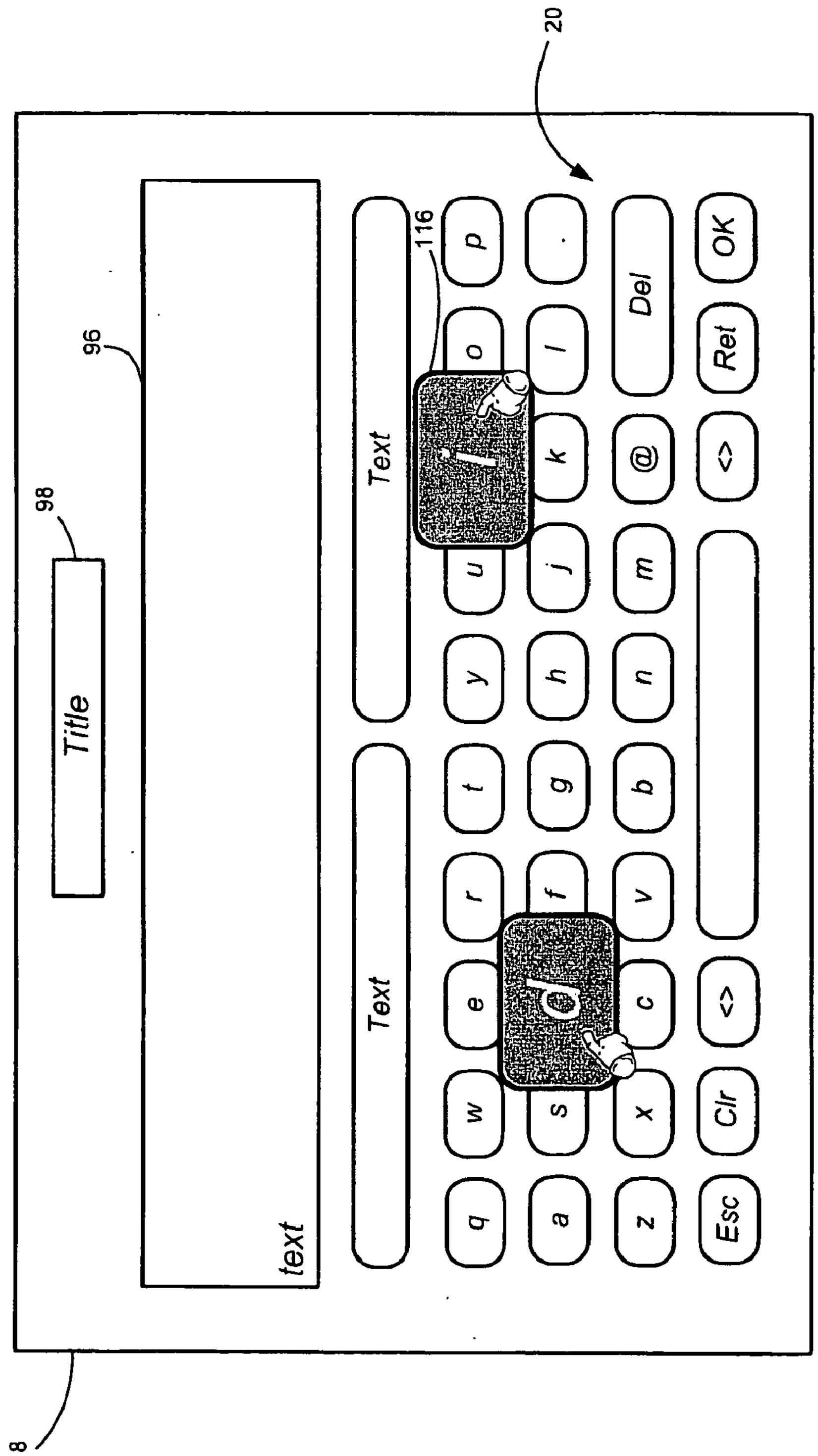
20
96
98
116
18
Title
text
Text
Text
q
w
e
r
t
y
u
i
o
p
a
s
d
f
g
h
j
k
l
.
z
x
c
v
b
n
m
@
Del
Esc
Clr
<>
<>
Ret
OK

Figure 10

VIRTUAL KEYPAD SYSTEMS AND METHODS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. patent applications Nos. 60/946858 and 11/977346, filed on Jun. 28, 2007 and Oct. 24, 2007, respectively. The disclosures of the above applications are incorporated herein by reference.

FIELD

[0002] The present invention relates to methods and systems for recognizing text input from a remote controller.

BACKGROUND ART

[0003] Many electronic consumer products come with remote control devices. These remote control devices can communicate a variety of commands to the electronic product. With the rise in technological advancements to the electronic products, the remote control devices have become complex to operate. For example, modern television remote controls can include selection buttons for volume, channel selection, menu selection, and picture viewing. To operate the remote control, the user must take time away from the program he or she is watching to focus in on the buttons. This can be very distracting to a viewer.

[0004] In addition, many Internet based services such as online shopping are now being provided through the television. Additional selection buttons such as keypad buttons must be included on the remote control device to accommodate these new services. The new selection buttons serve to increase the complexity as well as the cost of the remote control devices. Various solutions have been proposed to address such problems. One solution is disclosed in U.S. Pat. No. 6,765,557 to use a touchpad for controlling a home entertainment device such as an Interactive television. However, even this solution cannot completely solve the problems of inconveniency to the user inconvenience.

[0005] The statements in this section merely provide background information related to the present disclosure and may not constitute prior art.

SUMMARY

[0006] A virtual keypad system for inputting text is provided. A virtual keypad system includes a remote controller having at least one touchpad incorporated therein and divided into a plurality of touch zones. A display device is in data communication with the remote controller and is operable to display a user interface including a keypad, where each key of the keypad is mapped to a touch zone of the touchpad. A prediction module, in response to an operator pressing a given touch zone to select a particular character, performs one or more key prediction methods to predict one or more next plausible keys. A key mapping module remaps the touch zones of the touchpad to the keys of the keypad based on the one or more next plausible keys.

[0007] Further areas of applicability will become apparent from the description provided herein. It should be understood that the description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

BRIEF DESCRIPTION OF DRAWINGS

[0008] The drawings described herein are for illustration purposes only and are not intended to limit the scope of the present teachings in any way.

[0009] FIG. **1** is an illustration of a text input system according to various aspects of the present disclosure.

[0010] FIG. **2**A is an illustration of a remote controller of the text input system of FIG. **1** that includes a touchpad according to various aspects of the present disclosure.

[0011] FIG. **2**B is a block diagram illustrating internal components of the remote controller of FIG. **2**A according to various aspects of the present disclosure.

[0012] FIG. **3** is a dataflow diagram illustrating a virtual keypad module of the text input system of FIG. **1** according to various aspects of the present disclosure.

[0013] FIG. **4**A is an illustration of the remote controller being held in a portrait position according to various aspects of the present disclosure.

[0014] FIG. **4**B is an illustration of the remote controller being held in a landscape position according to various aspects of the present disclosure.

[0015] FIG. **5** is a table illustrating a mapping between XY coordinates of the touchpad and keys of a keypad.

[0016] FIG. **6** is a table illustrating a remapping between the coordinates of the touchpad and the keys of a keypad.

[0017] FIG. **7** is an illustration of a first embodiment of a virtual keypad graphical user interface according to various aspects of the present disclosure.

[0018] FIG. **8**A is an illustration of a second embodiment of a virtual keypad graphical user interface according to various aspects of the present disclosure.

[0019] FIG. **8**B is an illustration of a third embodiment of a virtual keypad graphical user interface according to various aspects of the present disclosure.

[0020] FIG. **9** is an illustration of a fourth embodiment of a virtual keypad graphical user interface according to various aspects of the present disclosure.

[0021] FIG. **10** is an illustration of a fifth embodiment of a virtual keypad graphical user interface according to various aspects of the present disclosure.

DETAILED DESCRIPTION

[0022] The following description is merely exemplary in nature and is not intended to limit the present teachings, their application, or uses. It should be understood that throughout the drawings, corresponding reference numerals indicate like or corresponding parts and features. As used herein, the term module or sub-module can refer to a processor (shared, dedicated, or group) and memory that executes one or more software or firmware to programs, and/or other suitable components that can provide the described functionality and/or combinations thereof.

[0023] Referring now to FIG. **1**, FIG. **1** depicts an exemplary text input system **10** implemented according to various aspects of the present disclosure. The exemplary text input system **10** includes a virtual keypad module **12** that facilitates the input of alphanumeric characters by a user for interacting with various services delivered through a display device **14**. The display device **14** can be, but is not limited to, a television (as shown), a projector and screen, or a computer. The services can be, for example, internet based services such as, online shopping and movie subscriptions. The virtual keypad module **12** provides feedback to the user via a graphical user interface (GUI) **18**. The GUI **18** includes a virtual keypad **20**, as will be discussed in more detail below.

[0024] In various embodiments, the virtual keypad module **12** can be implemented within the display device **14**. In various other embodiments, the virtual keypad module **12** can be implemented separate from the display device **14** (such as, for example, on a set top box (not shown)) and can be in data communication with the display device **14**. For ease of the discussion, the remainder of the disclosure will be discussed in the context of the virtual keypad module **12** being implemented within the display device **14**.

[0025] The text input system **10** further includes a remote controller **16** that generates one or more signals to the display device **14** in response to user input. The virtual keypad module **12** receives and processes the signals. Based on the signals, the virtual keypad module **12** determines an orientation and a holding position of the remote controller **16**, recognizes text input, and/or provides visual feedback to the user via a graphical user interface (GUI) **18**. In particular, the virtual keypad module **12** implements selection auto-correction methods that compensate for human typing (i.e., clicking) error. For example, when attempting to input text quickly, users can typically undershoot or overshoot the location and click on a nearby unintended key. The virtual keypad module **12** employs a combination of prediction and auto-correction methods to determine which character(s) is/are most likely to be entered by the user.

[0026] In one example, provided fast input speeds, a prediction method is used to compensate for the possible overshoot and undershoot. As will be discussed in more detail below, the predictions can be used to enlarge an activation area of possible keys while reducing (or zero-ing) activation areas of keys that are not in the next-character prediction list. However, if the prediction methods are unable to generate a prediction, even at fast input speeds, the virtual keypad module **12** disables the selection auto-correction methods and reverts to a default mode (i.e., without enlarging or reducing the activation area). The virtual keypad module **12** can also disable the selection auto-correction method when the interaction becomes slow because it is assumed that clicking errors do not generally occur during slow interaction.

[0027] FIGS. **2**A and **2**B illustrate an exemplary remote controller **16** according to various aspects of the present disclosure. As shown in FIG. **2**A, the exterior of the remote controller **16** includes a touchpad **22** and one or more soft keys **24***a*-**24***d*. In various embodiments, touch zones defined by one or more coordinates of the touchpad **22** can be mapped to a particular key of the virtual keypad **20** (FIG. **1**).

[0028] A user can select a particular key of the virtual keypad **20** by gently placing his finger or thumb on the touchpad **22** at or near the associated touch zone (FingerDown event), by dragging a finger or thumb along the touchpad **22** to the associated touch zone (FingerDrag event), and/or by lifting the finger or thumb away from the touchpad **22** (FingerUp event). While the user has a finger or thumb on the touchpad **22** (i.e., between FingerDown and FingerUp events), the user can click on the touchpad **22** by applying greater force (FingerPress event) followed by releasing the force (FingerRelease event) to select a key.

[0029] In various other embodiments, a relative access method can be used as an alternative or as a secondary method for selecting keys. The relative access method assumes a position of the user's finger or thumb to be a current coordinate or touch zone of the touchpad **22**. Subsequent gestures by the user are then interpreted relative to that coordinate or touch zone. This allows for an adjustable precision in selection.

[0030] Important functions of the remote controller **16** (such as, for example, volume, channel, and mute) can be associated with specific selection buttons **26***a*-**26***d* of the touchpad **22**. The selection buttons **26***a*-**26***d* can be designated by a specific touchpad button that is painted or illuminated on the touchpad **22** (as shown) or by a button displayed on an overlay to the virtual keypad **20** (FIG. **1**) of the GUI **18** (FIG. **1**). This allows the user to use the remote controller **16** in complete darkness without having to look away from the content being displayed on the display device **14** (FIG. **1**).

[0031] The functions can be controlled by simply touching the buttons or be controlled by performing a specific gesture. In one example, sliding a finger or thumb up or down on the right side of the touchpad **22** can trigger a volume up or volume down action. In another example, sliding a finger or thumb right or left on the top side of the touchpad **22** can trigger a channel up or channel down action.

[0032] In various embodiments, the body of the remote controller **16** can be made of a soft material, allowing the remote controller **16** to be squeezed. The squeezing of the remote controller **16** can be performed by the user to trigger certain actions, particularly in contexts where the GUI **18** (FIG. **1**) is just waiting for an acknowledgement without proposing a choice (such as a "next" button in a slideshow).

[0033] As shown in FIG. **2**B, the internal components of the remote controller **16** can include, but are not limited to, input sensors **30**, output actuators **32**, an input controller **34**, an output controller **36**, a processing handler **38**, a wireless transmitter (e.g., RF, Bluetooth, etc.) **40**, and/or combinations thereof. The following describes operations performed by the sensors including the input sensors **30**. The inputs sensors **30** can include touchpad sensors **42**. The touchpad sensors **42** can be single-position registering touchpad sensors mounted side-by-side that allow for the selection of at least two contact points on the touchpad **22** (FIG. **2**A) simultaneously. Alternatively, the touchpad sensors **42** can be a single multi-touch capable touchpad sensor that can register, with equal precision, two points of contact at the same time. In various embodiments, the touchpad sensors **42** can register pressure information to allow the touchpad **22** (FIG. **2**A) to be clickable.

[0034] The input sensors **30** can also include one or more selection button sensors **44**, one or more touchpad button sensors **46**, one or more accelerometers **48**, and one or more holding sensors **50**. The holding sensors **50** can be, for example, capacitive sensors that are located around the border of the remote controller **16**, and/or behind the remote controller **16**. The holding sensors **50** indicate whether the user is touching an area of the remote controller **16** in a proximity of the holding sensor **50**. The accelerometer **48** can be a three-axis accelerometer that indicates a positioning of the remote controller **16**. The input controller **34** reads the real-time data from all active sensors. In various embodiments, some sensors may not be active at all times to reduce power consumption. The processing handler **38** gathers and forms into packets the data to be transmitted and/or processes the real-time data from one or more active sensors to perform local actions.

The RF transmitter **40** (RF driver **40**) generates the signals in packet form to the display device **14** (FIG. **1**).

[0035] The output actuators **32** can include one or more LED panels **52** for displaying the touchpad buttons **26***a*-**26***d*, depending on the specific state of interaction with the GUI **18** present on-screen. The output actuators **32** can additionally or alternatively include actuators for providing sufficient haptic feedback to the user (such as, for example, vibration actuators **54**, light actuators **55**, and/or speaker actuators **56**). The above has described one example of the operations performed by the output actuator **32**. The output controller **36** updates the state of all the active actuators.

[0036] Referring now to FIG. **3**, a dataflow diagram illustrates a more detailed exemplary virtual keypad module **12**. Various embodiments of the virtual keypad module **12** according to the present disclosure may include any number of sub-modules. As can be appreciated, the sub-modules shown in FIG. **3** may be combined and/or further partitioned to similarly perform text input. The data inputs **70**, **72**, **74**, and **76** to the virtual keypad module **12** are received from the remote controller **16** (FIG. **1**) and/or received from other modules (not shown) within the display device **14** (FIG. **1**). In various embodiments, the virtual keypad module **12** includes an orientation recognition module **60**, a hand position recognition module **62**, a prediction module **64**, a key input module **66**, a key mapping module **67**, and a GUI manager module **68**. The following describes one example of operations performed by each module. The orientation recognition module **60** determines an orientation of the remote controller **16** based on data received from the holding sensors **50** (FIG. **2**B) and the accelerometer **48** (FIG. **2**B). For example, the user can be holding the remote controller **16** (FIG. **2**A) in a portrait position, as shown in FIG. **4**A, or in a landscape position, as shown in FIG. **4**B. In various embodiments, the orientation recognition module **60** determines the orientation by way of an Artificial Neural Network (ANN). The ANN can be trained by data indicating both landscape position conditions and portrait position conditions.

[0037] In one example, the orientation is determined by training an ANN with sensory data. The sensory data can comprise three-dimensional acceleration (accx, accy, accz) and an activation state of the n capacitive holding position sensors, which can signal that human skin is ever in proximity (1) or is not in proximity (0). These n+3 values are fed into a single perceptron or linear classifier to determine if the remote controller **16** (FIG. **2**A) is horizontal or vertical. Perceptron coefficients can be trained on a database and hard-coded by a manufacturer. The hand position recognition module **62** determines a holding style of the remote controller **16** (FIG. **2**A) based on data received from the holding sensors **50** (FIG. **2**B) and the accelerometer **48** (FIG. **2**B). For example, the sensory data **70**, **72** can be used to determine whether the remote controller **16** (FIG. **2**A) is held with one or two hands; and if it is held with one hand, whether it is held with the left or right hand. In various embodiments, the hand position recognition module **62** determines the holding style by way of an ANN. The ANN can be trained by data indicating right-hand conditions, left-hand conditions, and two hands conditions.

[0038] In one example, the hand position is determined similarly as discussed above. Multiple perceptrons can be implemented for the more than one binary decisions (e.g., left hand, right hand, two handed).

[0039] As will be discussed in more detail below, the determination of the orientation and the holding style gives the virtual keypad module **12** the ability to accommodate the user by automatically adapting the text input methods and the look and feel of the GUI **18** (FIG. **1**). Thus, the determination of the orientation and holding position allows the user to hold the remote controller **16** (FIG. **2**A) in the most convenient way based on their personal preference and the actual conditions of use (e.g., standing, sitting, lying down). In the case of operating the remote controller **16** (FIG. **2**A) in a dark room, the user can pick up and operate the remote controller **16** (FIG. **2**A) without worrying about how they are holding it.

[0040] The hand position recognition module **62** can further perform user verification based on a combination of holding sensor data **70**, accelerometer data **72**, additional sensor information (such as an image of the palm of the user's hand), and/or bio-sensors. The data can be used to fully determine the identity of the user or, more broadly, infer the category to which the user belongs (e.g., left-handed, right-handed, kid, adult, elderly). User identification can be used, for example, for parental control, personalization, and profile switching. User categorization can be used to adapt the GUI **18** (FIG. **1**).

[0041] The key mapping module **67** generates a map indicating an association between the coordinates or touch zones of the touchpad **22** (FIG. **2**A) and the keys of the keypad and/or touchpad selection buttons. In various embodiments, the key mapping module **67** generates the map based on the orientation and hand position information determined from the orientation recognition module **60** and the hand position recognition module **62**, respectively. The key mapping module **67** maps the touch zones of the touchpad **22** to the keys of the keypad, by associating a key of the keypad to each XY coordinate of the touch zones. Here, the touch zones are defined by one or more XY coordinates of the touchpad **22**. The key mapping module **67** generates a map from the mapping. Here, the map is a two-dimensional lookup table defined by the coordinates of the touchpad **22**. For example, as shown in FIG. **5**, the map can be a two dimensional (XY) table **80** that is used to assign a key of the keypad and/or a touchpad selection button to each coordinate of the touchpad **22** (FIG. **2**A). As will be discussed in more detail below, the map can then be referenced by the key input module **66** to determine an action to be taken and can be referenced by the GUI manager module **68** to generate the GUI **18** (FIG. **1**).

[0042] Referring back to FIG. **3**, the key input module **66** processes touchpad sensor data **74** and/or the accelerometer data **72**. In various embodiments, the key input module **66** interprets the touchpad sensor data **74** to be a coordinate or coordinates of the touchpad **22** (FIG. **2**A) and determines what action to be taken based on the coordinate or coordinates. For example, the key input module **66** can receive the touchpad sensor data **74**, determine a particular coordinate from the data **74**, and reference the map generated by the key mapping module **67**. Based on the entries in the map, the key input module **66**, for example, can project that the user is hovering over a particular key of the keypad and, thus, entering a particular text.

[0043] In various embodiments, the key input module **66** interprets the accelerometer data **72** as an action to be taken. For example, the accelerometer data **72** can indicate if a user has lifted the remote controller **16** (FIG. **2**A) quickly to select, for example, an uppercase mode. The accelerometer data **72**

can indicate when a user has lowered the remote controller **16** (FIG. **2**A) quickly to select, for example, a lowercase mode.

[0044] To enhance the precision and speed at which the text is entered, the prediction module **64** generates a prediction of which key and/or word the user is trying to select. The prediction module **64** generates the prediction based on the touchpad sensor data **74** and/or based on a determination of previous text entered. In various embodiments, the prediction module **64** performs one or more next key prediction methods, such as, for example, a language model method, a trajectory analysis method, a hand movement analysis method, a timing analysis method, and/or combinations thereof. In short, the prediction module **64**, in response to an operator pressing a given touch zone to select a particular character, performs one or more key prediction methods to predict one or more next plausible keys. Examples of the operator are a finger of the user, a touch-pen, and the like, that operates the touchpad **22**.

[0045] In one example, the prediction module **64** employs one or more language models known in the art to predict the next key based on previous text entered. The language models, for instance, predict the one or more next plausible keys based on previous characters selected by the operator. For example, if the partial word 'pr' has been entered, the language model can predict that a vowel is likely to follow and that the letter 'r' will not be a possibility.

[0046] In another example, the prediction module **64** employs one or more language models to provide a list of reliable candidates of full words from partial word inputs. In this case, the language model generates a list of plausible words based on the previous characters selected by the operator. The full words can be selected by the user for autocompletion. For example, if the partial word 'Pan' has been entered, a list can be generated that includes 'Panasonic' and 'Pan-American.' Instead of typing the remaining characters, the user can simply select one of the full words.

[0047] In various embodiments, the language model can generate the word predictions based on words previously entered. For example, once selected, the words can be remembered and the language model can be adapted to favor the remembered words.

[0048] In yet another example, the trajectory analysis method can be performed to predict possible next keys based on future path estimation including directions and/or velocities of user's finger or thumb movement on the touchpad **22** (FIG. **2**A) as indicated by the touchpad sensor data **74**. The trajectory analysis method predicts next plausible keys based on a direction of operator movement on the touchpad **22**. For example, if the user first selects the 'k' key and the language model predicts that the next key can be one of 'I,' 'e,' or 'a,' the touchpad sensor data **74** can be evaluated to determine a direction the user is heading and velocity of the movement and, thus, eliminate one or more of the choices.

[0049] For example, the trajectory analysis method determines a coordinate of the key 'k' and subsequent finger movements. From that history of XY coordinates, the future path is determined. The path includes a tolerance to account for short-term prediction (more accurate) and longer-term prediction (less accurate). If the future path estimation is heading away from the coordinates of the predicted key, the choice is eliminated. For example, if the path is heading on an Up/Left diagonal line, then the keys 'e' and 'a' are eliminated and the key 'I' is selected as the predicted next key.

[0050] In another example, the hand movement analysis method can be performed using the holding style information provided by the hand position recognition module **62** and the predictions provided by the prediction module **64**. The hand movement analysis method predicts next plausible keys based on a detection of which hand is moving on the touchpad **22**. The hand movement analysis method can evaluate whether the remote controller **16** (FIG. **2**A) is held with two hands or one hand. If the remote controller **16** (FIG. **2**A) is held by two hands and movement by a right hand or left hand is detected, then the choices that are associated with the non-moving hand would be eliminated.

[0051] For example, if the user first selects the 'k' key, the prediction module **64** predicts that the next key can be one of 'e,' or 'a,' and movement is detected by the right hand, then the keys 'e' and 'a' are eliminated and the key 'I' is selected as the predicted next key.

[0052] In yet another example, the timing analysis method can be performed when the prediction module **64** is unable to predict the appropriate next key or word via any of the next key prediction methods. Such may be the case when the user is entering proper nouns, such as a last name or a password. The timing analysis method evaluates the time the user takes to move from one key to the next. That is, the timing analysis method predicts next plausible keys based on a timing of operator movement on the touchpad **22**. In more detail, the timing analysis method predicts no next plausible keys when the timing exceeds a predetermined limit. Here, the key mapping module **67** remaps the touch zones of the touchpad **22** to the keys of the keypad based on the no next plausible keys. If the user moves more slowly, it is more likely that a proper noun is being entered. The predictions are then ignored.

[0053] Based on the predictions provided by the prediction module **64**, the key mapping module **67** can remap the coordinates of the touchpad **22** (FIG. **2**A) to the keys of the virtual keypad **20** (FIG. **1**). That is, the key mapping module **67** remaps the touch zones of the touchpad **22** to the keys of the keypad based on the one or more next plausible keys predicted by the prediction module **64**. In various embodiments, the coordinates that are associated with the predicted next key can be expanded to make the key more accessible. For example, as shown in FIG. **6**, if the predicted next key is 'p,' the map can be adjusted such that the coordinates that were previously mapped to the keys 'o' or 'I' are now mapped to the key 'p.' Thus, if the user is actually hovering over the 'I' key, the 'p' key will be selected and entered if the user clicks on the touchpad **22** (FIG. **2**A).

[0054] Referring back to FIG. **3**, in various embodiments, the key mapping module **67** can remap the coordinates to the keys based on a relative speed of the user movement. For example, the key mapping module **67** can remap the coordinates such that the predicted key is mapped to a larger touch zone area when a faster movement is detected. The key mapping module **67** can maintain the original coordinates or remap to the original coordinates when slower movements are detected. The key mapping module **67** can scale the area between the larger area and the original area when a movement that is not fast or slow is detected.

[0055] The GUI manager module **68** generates GUI data **76** for displaying the GUI **18**. The GUI **18** provides visual feedback to the user indicating the actions they have performed with the remote controller **16** (FIG. **2**A). As shown in the exemplary GUIs **18** of FIGS. **7** through **10**, the GUI **18** can include the virtual keypad **20**, including multiple alphanumeric keys **90**, one or more selection buttons **92**, a selection list **94**, a text display box **96**, a title bar **98**, and/or combinations thereof.

[0056] As discussed further below, the touchpad **22** is divided into two operating zones (a first operating zone and a second operating zone). The key mapping module **67** maps a first subset of keys of the keypad to the first operating zone of the touchpad **22** and maps a second subset of keys of the keypad to the second operating zone of the touchpad **22**. For example, the first operating zone corresponds to a top zone or a right zone of the touchpad **22**, and the second operating zone corresponds to a bottom zone or a left zone of the touchpad **22**. Here, each of the first subset and the second subset is a group of keys of the keypad. In various embodiments, the GUI manager module **68** displays the virtual keypad **20** based on the holding position and the orientation determined by the hand position recognition module **62** and the orientation recognition module **60**, respectively. For example, as shown in FIG. **7**, if two hands are used to hold the remote controller **16** (FIG. **2**A) in the landscape position, the virtual keypad **20** and the touchpad **22** can be divided into two zones **100**, **102** (e.g., left and right). The keys in the right zone **102** can be associated with a first zone **104** of the touchpad **22**, and the keys in the left zone **100** can be associated with a second zone **106** of the touchpad **22**. The user can select a key **90** in the right zone **102** with a right thumb or finger, and the user can select a key **90** in the left zone **100** with a left thumb or finger. The keys **90** in each zone **100**, **102** can be distinguished by a particular color or shading of the keys **90** so that the user can determine which keys **90** can be selected with which thumb or finger. This will allow for a natural text input, similar to the experience when entering text on classic keyboards.

[0057] In this example, selection of a predicted word (auto-completion) can be made through the display of the two most probable words (e.g., 'Panasonic,' 'Pan-America'). The selection buttons **92** are auto-completion selection buttons. When the user selects one of the selection buttons **92**, a probable word displayed in the selected selection button **92** is displayed as a complete word on the display box **96**. For example, the two words can be displayed on selection buttons **92**. The user can select the selection buttons **92** by pushing soft keys **24***b*, **24***d* located on the top side of the remote controller **16** with the index fingers, or by dragging the finger or thumb to a dedicated zone located at a designated location of the touchpad **22**.

[0058] In various embodiments, when the touchpad **22** and the virtual keypad **20** are divided into two zones, the mapping of the coordinates can provide for an overlap between the two areas. The key mapping module **67** maps a third subset of keys of the first subset of keys to the second operating zone and maps a fourth subset of keys of the second subset of keys to the first operating zone. For instance, the third subset of keys include the keys designated by the letters 't,' 'g,' and 'b' of the keys of the first subset (keys included in the zone **100** of FIG. **7**). Likewise, the fourth subset of keys include the keys designated by the letters 'y,' 'h,' and 'n' of the keys of the second subset (keys included in the zone **102** of FIG. **7**). That enables the keys along a boundary between the divided zones to operate for any zones of the touchpad **22**. For example, the letter 'g' in left keyboard area can be selected by the touchpad **22** in the first zone, as well as be selected by the touchpad **22** in the second zone **106**. The overlap keys can be identified on the GUI **18** by shading or color.

[0059] Referring now to FIGS. **8**A and **8**B, in another example, if two hands are used to hold the remote controller **16** in the landscape position, the touchpad **22** can be divided into two zones **108**, **110** or **112**, **114**. The virtual keypad **20**, however, is not divided. A first zone **110** or **114** of the touchpad **22** can be associated with the entire virtual keypad **20**, and can be referred to as the "Key-Entry Zone." The second zone **108** or **112** of the touchpad **22** can be associated with the auto-completion buttons **92** (FIG. **7**) or selection lists **94** (auto-completion selection list), and can be referred to as the "Auto-Completion Zone." The auto-completion buttons **92** or selection lists **94** can be displayed when the user touches the touchpad **22** in the "Auto-Completion Zone." The user interface can include a small visual notification to signal the availability and status of auto-completion words. This way the user will not be bothered with auto-completion unless he decides to use it.

[0060] In various embodiments, the zones **108**, **110** or **112**, **114** of the touchpad **22** can be configured based on an identification of the user. For example, in the case of a right-handed user, the right zone **110** can be associated with the "Key-Entry Zone" used most often and the left zone **108** can be associated with the "Auto-Completion Zone." Similarly, for a left-handed user, the left zone **108** can be associated with the "Key-Entry Zone" used most often and the right zone **110** can be associated with the "Auto-Completion Zone."

[0061] Referring now to FIG. **9**, in yet another example, if one hand is used to hold the remote controller **16** in the portrait position, the touchpad **22** is divided into zones. The virtual keypad **20**, however, is not divided into zones. Only one zone of the touchpad **22** is used by the user at all times. The user will be able to address the entire virtual keypad **20** from the entire touchpad **22**. Such touchpad **22** will principally function as the "Key-Entry Zone." If auto-completion is needed, the user can switch the touchpad **22** to the "Auto-completion Zone" by using a simple gesture. Such gesture can include, but is not limited to, moving the thumb or finger to a specific area of the touchpad **22** (for instance lower right), or sliding the finger or thumb along the touchpad **22** quickly from right to left.

[0062] In any of the examples shown in FIGS. **7** through **9**, the user can select a key **90** by dragging the thumb or finger on the touchpad **22**. In response to the movement, one or more on-screen pointers (such as, for example, a cursor, or an illustration of a thumb or finger) slides to a target key **90**. The on-screen pointers can be displayed according to the hand position (e.g., left hand only, right hand only, or both hands). The key **90** can be selected by clicking the clickable touchpad **22** and/or upon release. When displaying a thumb or finger as the pointer, a different thumb or finger posture can be used to indicate a thumb or finger press as opposed to a thumb or finger that is dragged on the touchpad surface. The selected character associated with the key will be displayed in the text display box **96**.

[0063] Referring now to FIG. **10**, in various embodiments, the GUI manager module **68** displays the keys **90** of the virtual keypad **20** based on the predicted next key and the remapping of the coordinates performed by the key mapping module **67** (FIG. **3**). For example, by knowing the next likely key, the GUI manager module **68** (FIG. **3**) can highlight and/or enlarge the most likely key **116** based on the mapping of the coordinates. That is, an arrangement of the keypad on the user interface is modified based on the one or more next plausible keys predicted by the prediction module **64**. In more detail, one or more keys of the keypad on the user interface is highlighted or enlarged based on the one or more next plausible keys predicted by the prediction module **64**. These operations are performed by the GUI manager module **68**. However, when the user is not moving the cursor quickly or the user hovers over a given coordinate, the highlighted and/or enlarged key **116** is remapped to the original coordinates of the touchpad **22** and the highlighted and/or enlarged key can be resized back to the original size.

[0064] Those skilled in the art can now appreciate from the foregoing description that the broad teachings of the present disclosure can be implemented in a variety of forms. Therefore, while this disclosure has been described in connection with particular examples thereof, the true scope of the disclosure should not be so limited since other modifications will become apparent to the skilled practitioner upon a study of the drawings, specification, and the following claims.

1. A virtual keypad system for inputting text, comprising:

a remote controller having at least one touchpad incorporated therein and divided into a plurality of touch zones;

a display device in data communication with the remote controller and operable to display a user interface including a keypad, where each key of the keypad is mapped to a touch zone of the touchpad;

a prediction module, in response to an operator pressing a given touch zone to select a particular character, performs one or more key prediction methods to predict one or more next plausible keys; and

a key mapping module remaps the touch zones of the touchpad to the keys of the keypad based on the one or more next plausible keys.

2. The system of claim **1**,

wherein an arrangement of the keypad on the user interface is modified based on the one or more next plausible keys.

3. The system of claim **2**,

wherein one or more keys of the keypad on the user interface is enlarged based on the one or more next plausible keys.

4. The system of claim **2**,

wherein one or more keys of the keypad on the user interface is highlighted based on the one or more next plausible keys.

5. The system of claim **1** further comprising

a language model operable to predict the one or more next plausible keys based on previous characters selected by the operator.

6. The system of claim **5**,

wherein the language model is further operable to generate a list of plausible words based on the previous characters selected by the operator.

7. The system of claim **1**,

wherein the one or more key prediction methods includes a trajectory analysis method, where the next plausible key is predicted based on a direction of operator movement on the touchpad.

8. The system of claim **1**,

wherein the one or more key prediction methods includes a hand movement analysis method, where the next plausible key is predicted based on a detection of which hand is moving on the touchpad.

9. The system of claim **1**,

wherein the touchpad is divided into two operating zones and wherein the key mapping module maps a first subset of keys of the keypad to a first operating zone of the touchpad and maps a second subset of keys of the keypad to a second operating zone of the touchpad.

10. The system of claim **9**,

wherein the first operating zone corresponds to a top zone of the touchpad and wherein the second operating zone corresponds to a bottom zone of the touchpad.

11. The system of claim **9**,

wherein the first operating zone corresponds to a right zone of the touchpad and wherein the second operating zone corresponds to a left zone of the touch pad.

12. The system of claim **1**,

wherein the user interface includes at least one of auto-completion selection buttons and auto-completion selection list.

13. The system of claim **12**,

wherein the touchpad is divided into two operating zones and wherein the key mapping module maps a first operating zone to the keys of the keypad and maps a second operating zone to the at least one of the of auto-completion selection buttons and auto-completion selection.

14. The system of claim **9**,

wherein the key mapping module maps a third subset of keys of the first subset of keys to the second operating zone and maps a fourth subset of keys of the second subset of keys to the first operating zone.

15. The system of claim **14**,

wherein the third subset of keys include the keys designated. by the letters 't,' 'g,' and 'b,' and wherein the fourth subset of keys include the keys designated by the letters 'y,' 'h,' and 'n.'

16. The system of claim **1**,

wherein the key prediction methods include a timing analysis method, where the next plausible keys are predicted based on a timing of operator movement on the touchpad.

17. The system of claim **16**,

wherein the timing analysis method predicts no next plausible keys when the timing exceeds a predetermined limit.

18. The system of claim **17**,

wherein the key mapping module remaps the touch zones of the touchpad to the keys of the keypad based on the no next plausible keys.

19. The system of claim **1**,

wherein the touch zones are defined by one or more XY coordinates of the touchpad and wherein the key mapping module maps the touch zones of the touchpad to the keys of the keypad by associating a key of the keypad to each XY coordinate of the touch zones.

20. The system of claim **19**,

wherein the key mapping modules generates a map from the mapping and wherein the map is a two-dimensional lookup table defined by the coordinates of the touchpad.

21. A virtual keypad system for inputting text, comprising:

a remote controller having at least one touchpad incorporated therein and divided into a plurality of touch zones;

a display device in data communication with the remote controller and operable to display a keypad and an area for displaying input from the keypad, where each key on the keypad is associated with a touch zone on the touchpad and, in response to an operator pressing a given touch zone, a character on the key correlating to the given touch zone is displayed in an input area of the display;

a language model adapted to receive characters displayed in the input area and operable to predict next most plausible characters in string of received characters; and

a module that arranges the each key on the keypad for facilitating entry of a desired key based on output from the language model.

22. The system of claim **21**,

wherein the arranging comprises enlarging keys on the keypad based on the output from the language model.

23. A virtual keypad system for inputting text, comprising:

a remote controller having at least one touchpad incorporated therein and divided into a plurality of touch zones;

a display device in data communication with the remote controller and operable to display a user interface including a keypad, where each key of the keypad is mapped to a touch zone of the touchpad;

a prediction module performs one or more key prediction methods to predict one or more next plausible keys;

a key mapping module remaps the touch zones of the touchpad to the keys of the keypad based on the one or more next plausible keys;

a user interface manager module modifies an arrangement of the keypad based on the remapping of the touch zones of the touchpad to the keys of the keypad; and

a text input module, in response to an operator pressing a given touch zone, selects a key based on the remapping of the touch zones of the touchpad to the keys of the keypad.

24. The system of claim **23**,

wherein the user interface manager module enlarges one or more keys of the keypad based on the remapping of the touch zones of the touchpad to the keys of the keypad.

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