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(54) **TRANSLATING LANGUAGE CHARACTERS IN MEDIA CONTENT**

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(51) **Int. Cl.**

G06F 40/58	(2020.01)
G06F 3/04842	(2022.01)

(Continued)

(52) **U.S. Cl.**

CPC ***G06F 40/58*** (2020.01); ***G06F 3/04842*** (2013.01); ***G06F 3/0488*** (2013.01); ***G06F 16/5846*** (2019.01)

(58) **Field of Classification Search**

CPC G06F 40/58

See application file for complete search history.

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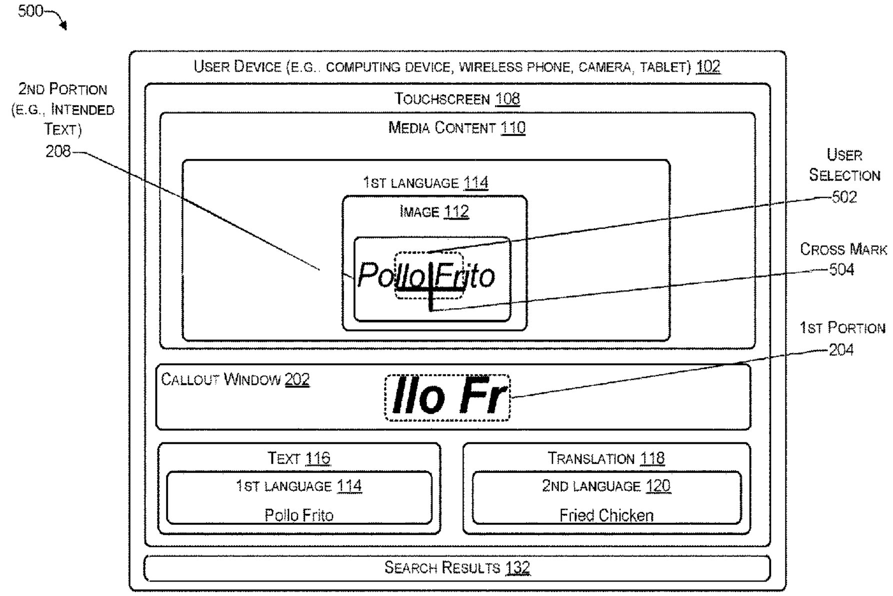
Primary Examiner — Jialong He

(57) **ABSTRACT**

Some implementations disclosed herein provide techniques and arrangements to enable translating language characters in media content. For example, some implementations receive a user selection of a first portion of media content. Some implementations disclosed herein may, based on the first portion, identify a second portion of the media content. The second portion of the media content may include one or more first characters of a first language. Some implementations disclosed herein may create an image that includes the second portion of the media content and may send the image to a server. Some implementations disclosed herein may receive one or more second characters of a second language corresponding to a translation of the one or more first characters of the first language from the server.

20 Claims, 11 Drawing Sheets



Related U.S. Application Data

continuation of application No. 16/284,256, filed on Feb. 25, 2019, now Pat. No. 11,030,420, which is a continuation of application No. 15/010,238, filed on Jan. 29, 2016, now Pat. No. 10,216,730, which is a continuation of application No. 13/277,109, filed on Oct. 19, 2011, now Pat. No. 9,251,144.

(51) **Int. Cl.**

G06F 3/0488	(2022.01)
G06F 16/583	(2019.01)

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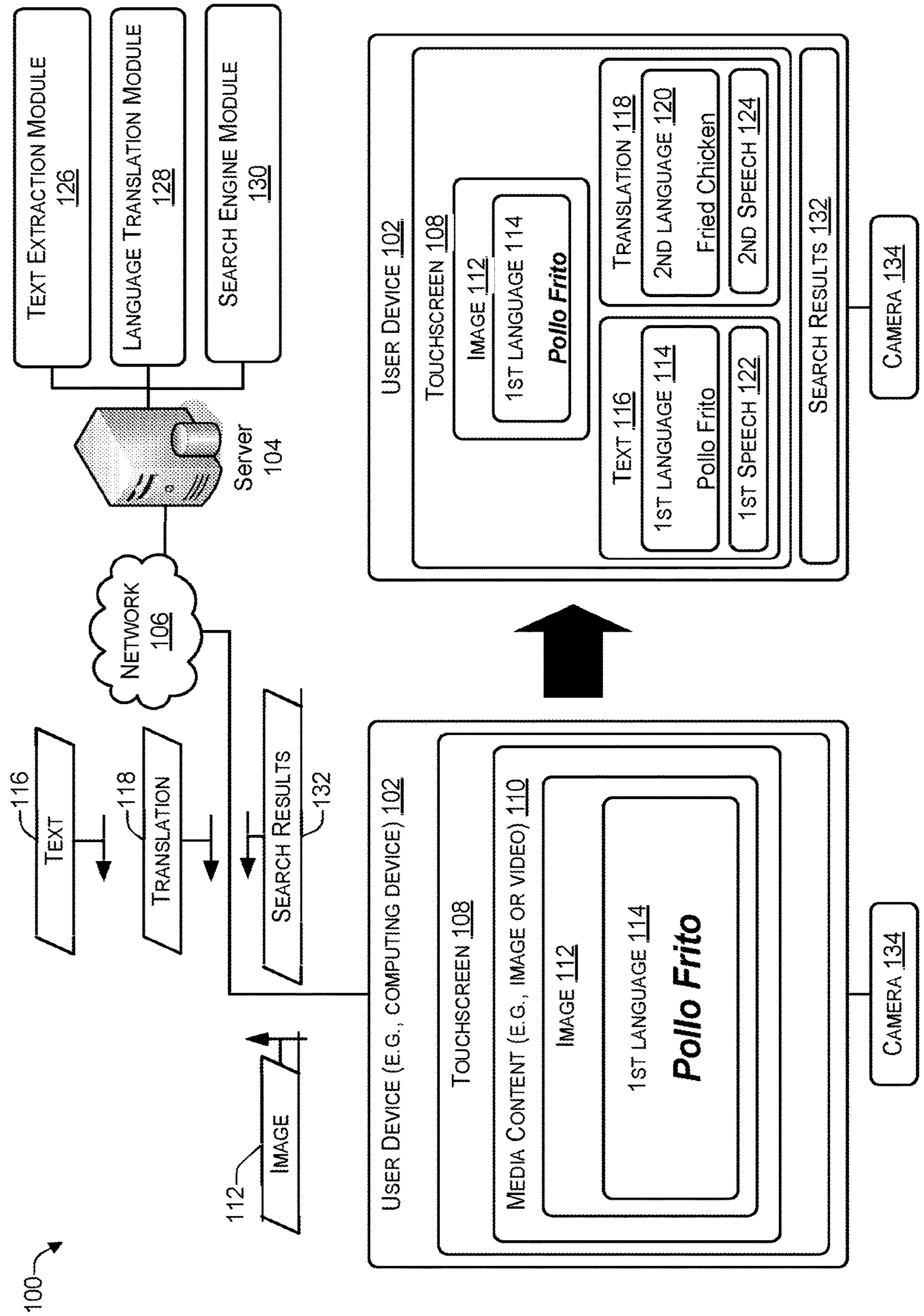
100
112
Image
Text
116
Translation
118
Search Results
132
Network
106
Server
104
Text Extraction Module
126
Language Translation Module
128
Search Engine Module
130
User Device (e.g., computing device) 102
Touchscreen 108
Media Content (e.g., image or video) 110
Image 112
1st language 114
Pollo Frito
Camera 134
User Device 102
Touchscreen 108
Image 112
1st language 114
Pollo Frito
Text 116
1st language 114
Pollo Frito
1st Speech 122
Translation 118
2nd language 120
Fried Chicken
2nd Speech 124
Search Results 132
Camera 134

FIG. 1

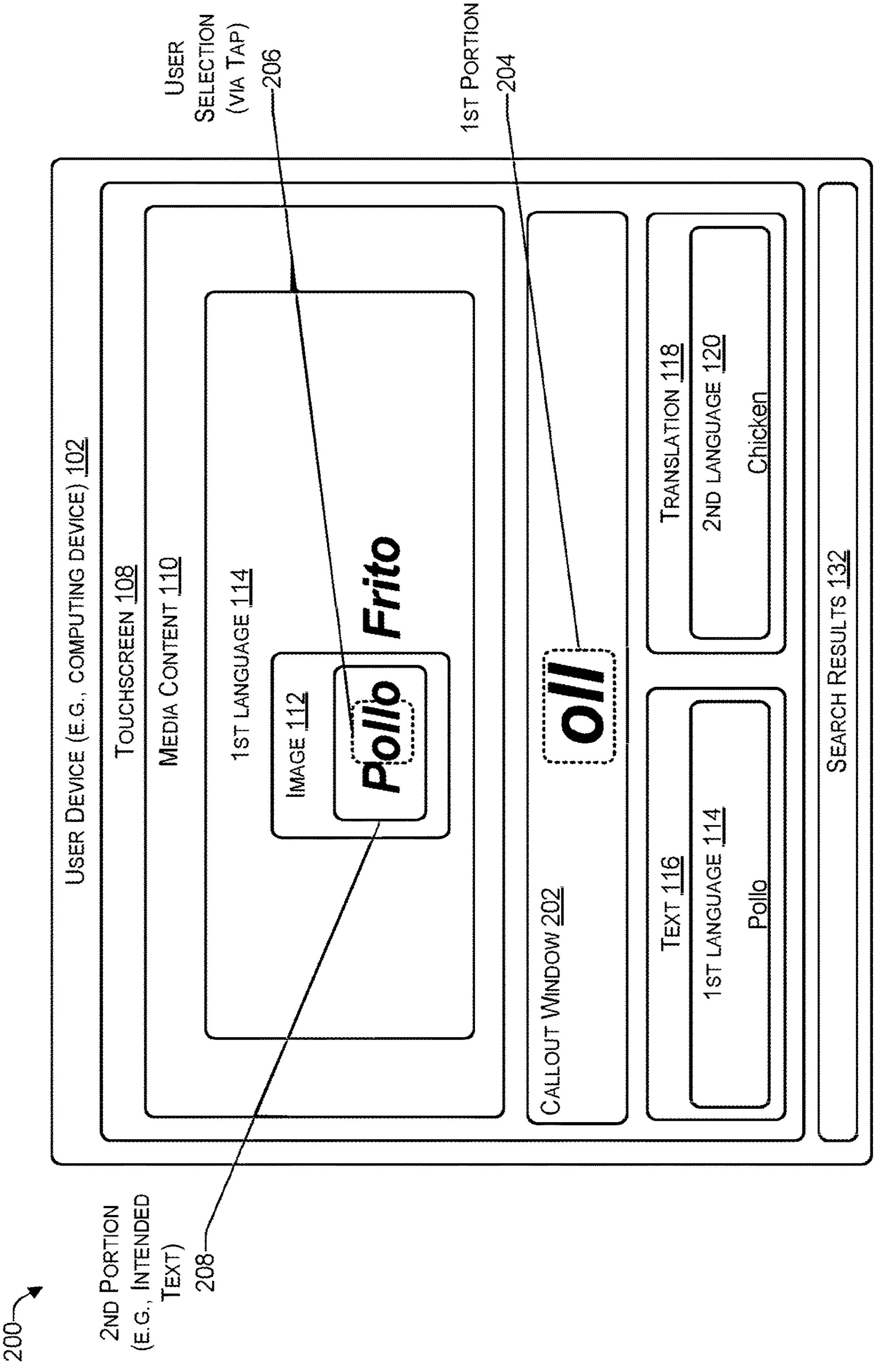
200
2ND PORTION (E.G., INTENDED TEXT) 208
USER SELECTION (VIA TAP) 206
1ST PORTION 204
USER DEVICE (E.G., COMPUTING DEVICE) 102
TOUCHSCREEN 108
MEDIA CONTENT 110
1ST LANGUAGE 114
IMAGE 112
Pollo
Frito
CALLOUT WINDOW 202
oll
TEXT 116
1ST LANGUAGE 114
Pollo
TRANSLATION 118
2ND LANGUAGE 120
Chicken
SEARCH RESULTS 132

FIG. 2

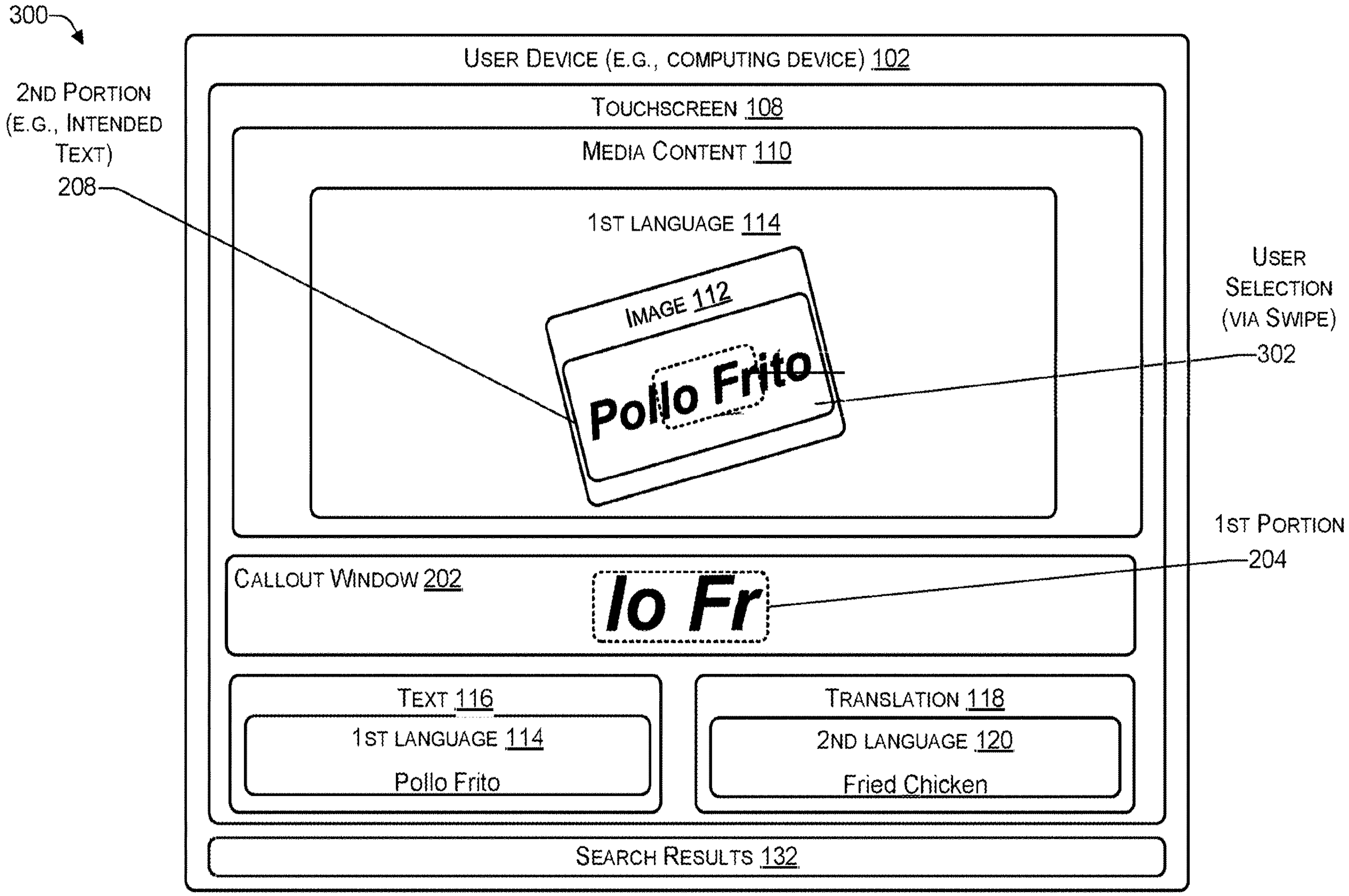
300
User Device (e.g., computing device) 102
Touchscreen 108
Media Content 110
1st language 114
Image 112
Pollo Frito
2nd Portion (e.g., Intended Text) 208
User Selection (via Swipe) 302
Callout Window 202
lo Fr
1st Portion 204
Text 116
1st language 114
Pollo Frito
Translation 118
2nd language 120
Fried Chicken
Search Results 132

FIG. 3

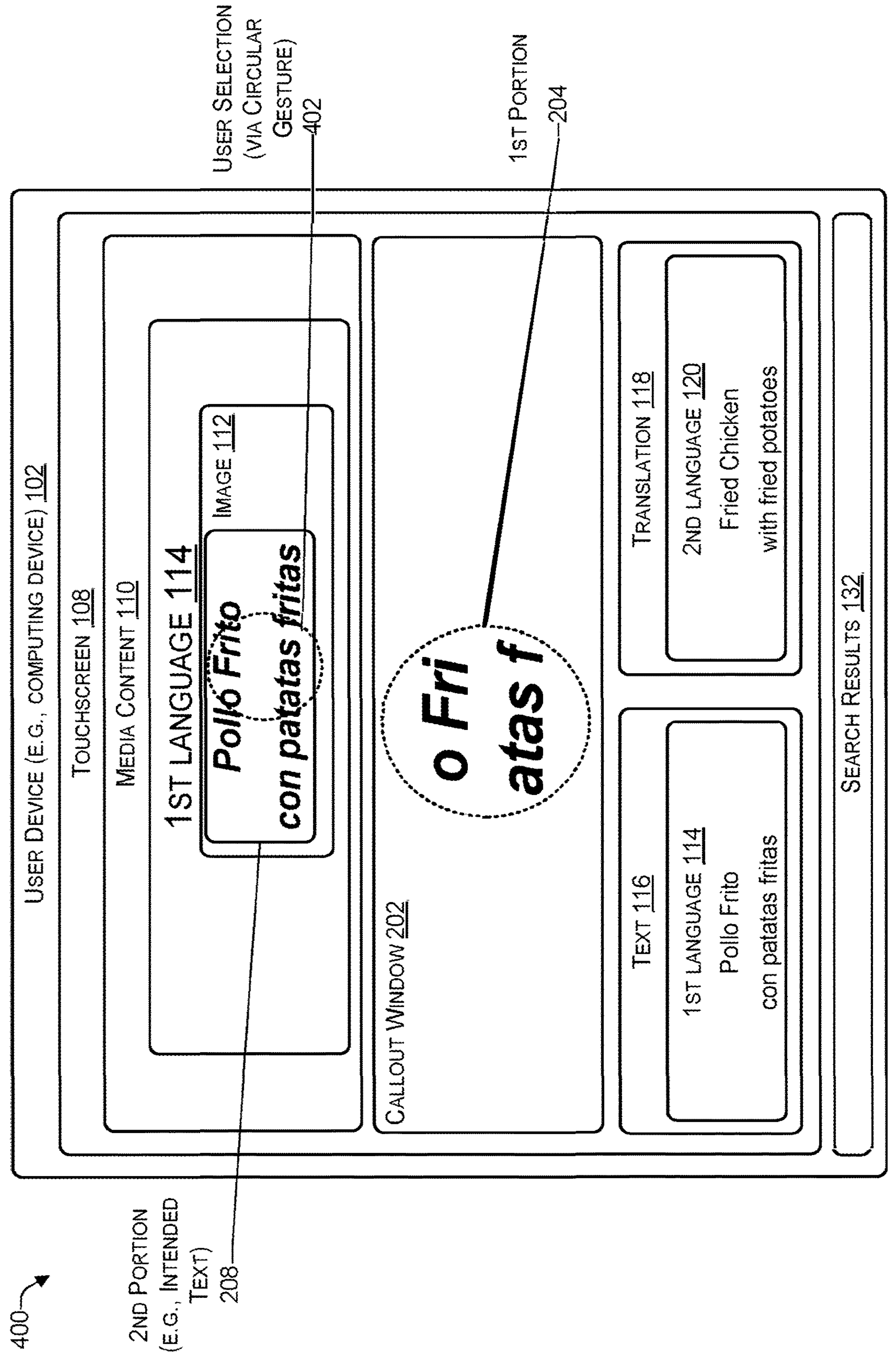
400
User Device (e.g., Computing Device) 102
Touchscreen 108
Media Content 110
1st Language 114
Image 112
Pollo Frito
con patatas fritas
User Selection (via Circular Gesture) 402
2nd Portion (e.g., Intended Text) 208
Callout Window 202
o Fri
atas f
1st Portion 204
Text 116
1st Language 114
Pollo Frito
con patatas fritas
Translation 118
2nd Language 120
Fried Chicken
with fried potatoes
Search Results 132

FIG. 4

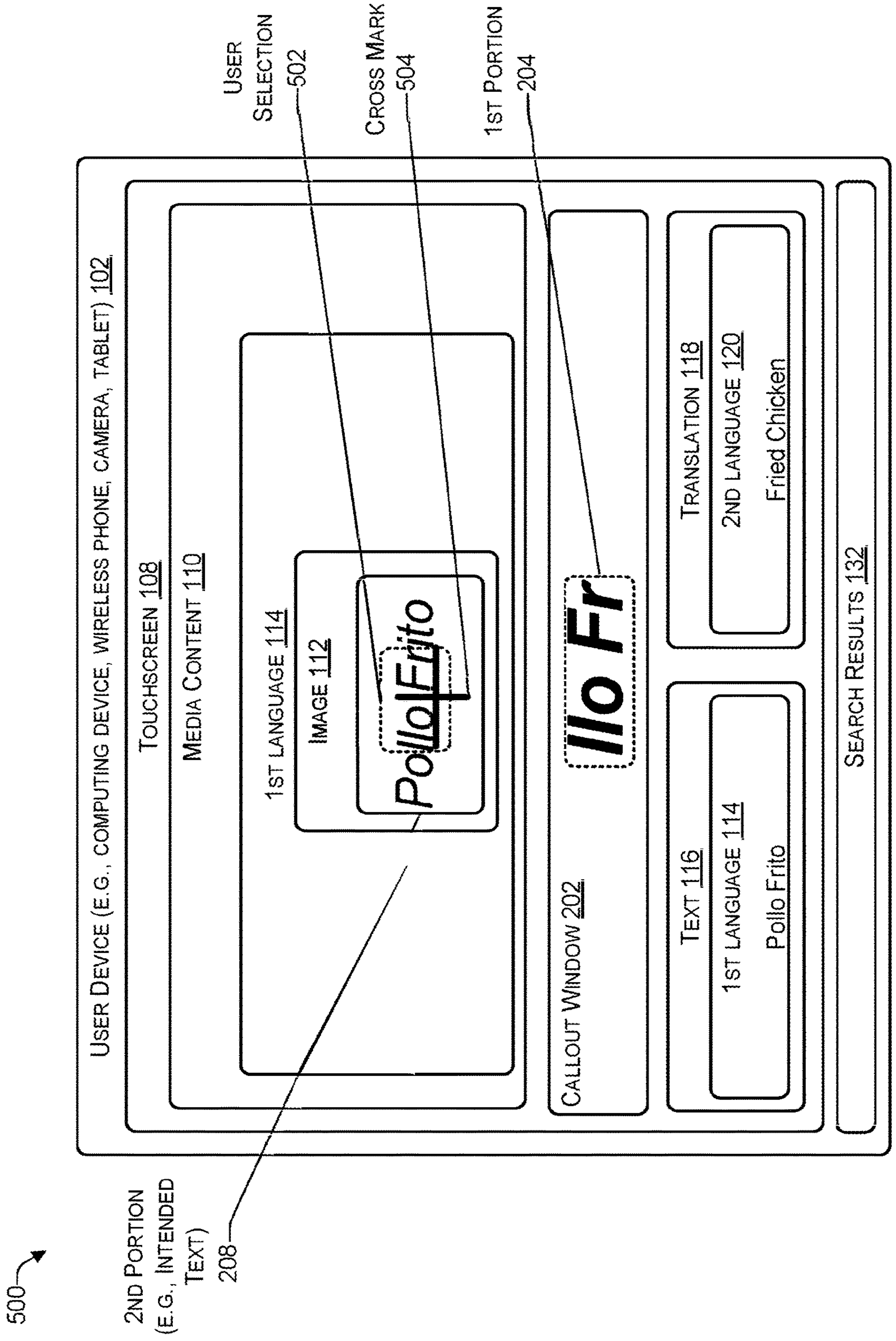
500
2ND PORTION (E.G., INTENDED TEXT) 208
USER SELECTION 502
CROSS MARK 504
1ST PORTION 204
USER DEVICE (E.G., COMPUTING DEVICE, WIRELESS PHONE, CAMERA, TABLET) 102
TOUCHSCREEN 108
MEDIA CONTENT 110
1ST LANGUAGE 114
IMAGE 112
Pollo Frito
CALLOUT WINDOW 202
llo Fr
TEXT 116
1ST LANGUAGE 114
Pollo Frito
TRANSLATION 118
2ND LANGUAGE 120
Fried Chicken
SEARCH RESULTS 132

FIG. 5

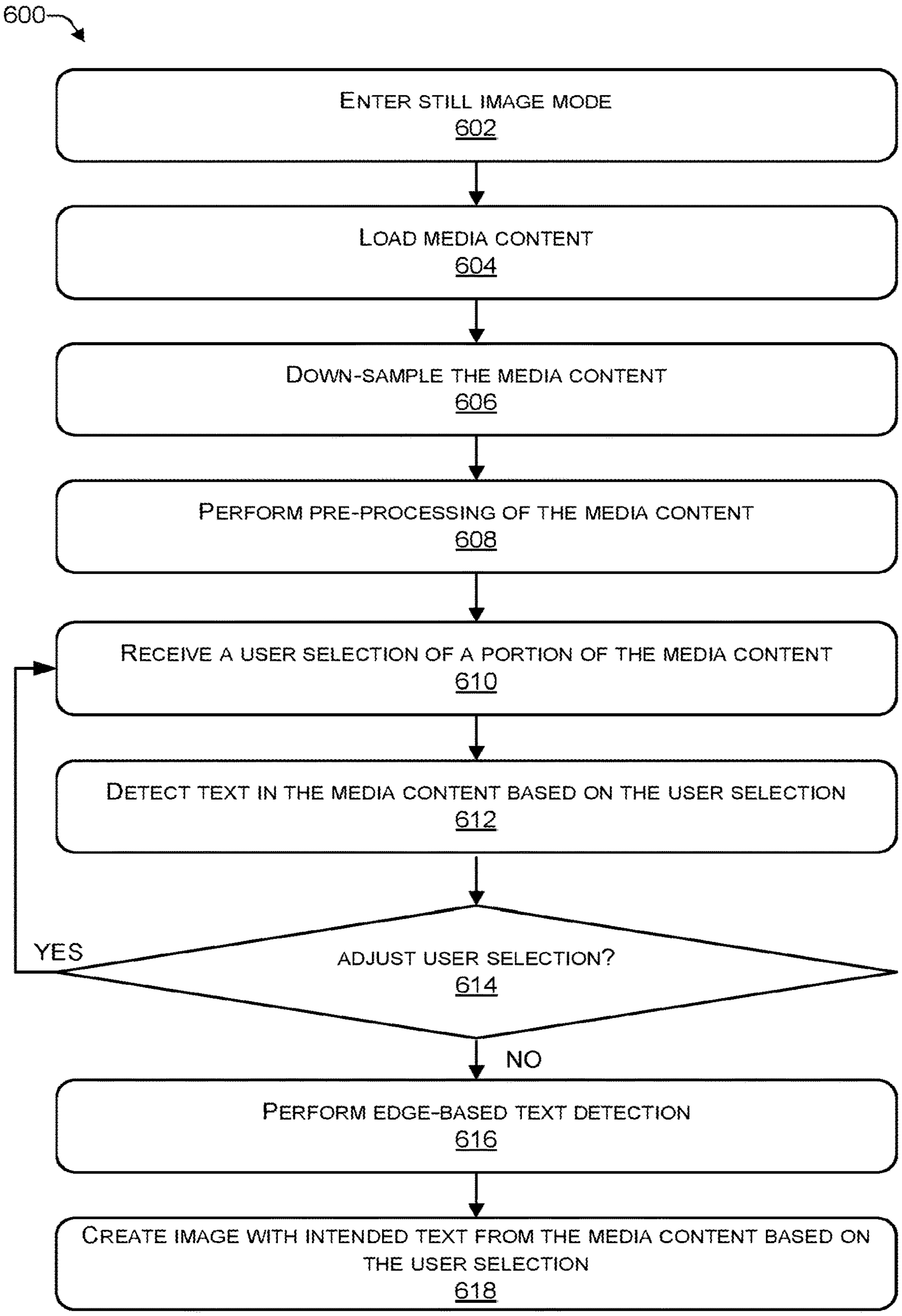
600
ENTER STILL IMAGE MODE
602
LOAD MEDIA CONTENT
604
DOWN-SAMPLE THE MEDIA CONTENT
606
PERFORM PRE-PROCESSING OF THE MEDIA CONTENT
608
RECEIVE A USER SELECTION OF A PORTION OF THE MEDIA CONTENT
610
DETECT TEXT IN THE MEDIA CONTENT BASED ON THE USER SELECTION
612
ADJUST USER SELECTION?
614
YES
NO
PERFORM EDGE-BASED TEXT DETECTION
616
CREATE IMAGE WITH INTENDED TEXT FROM THE MEDIA CONTENT BASED ON THE USER SELECTION
618

FIG. 6

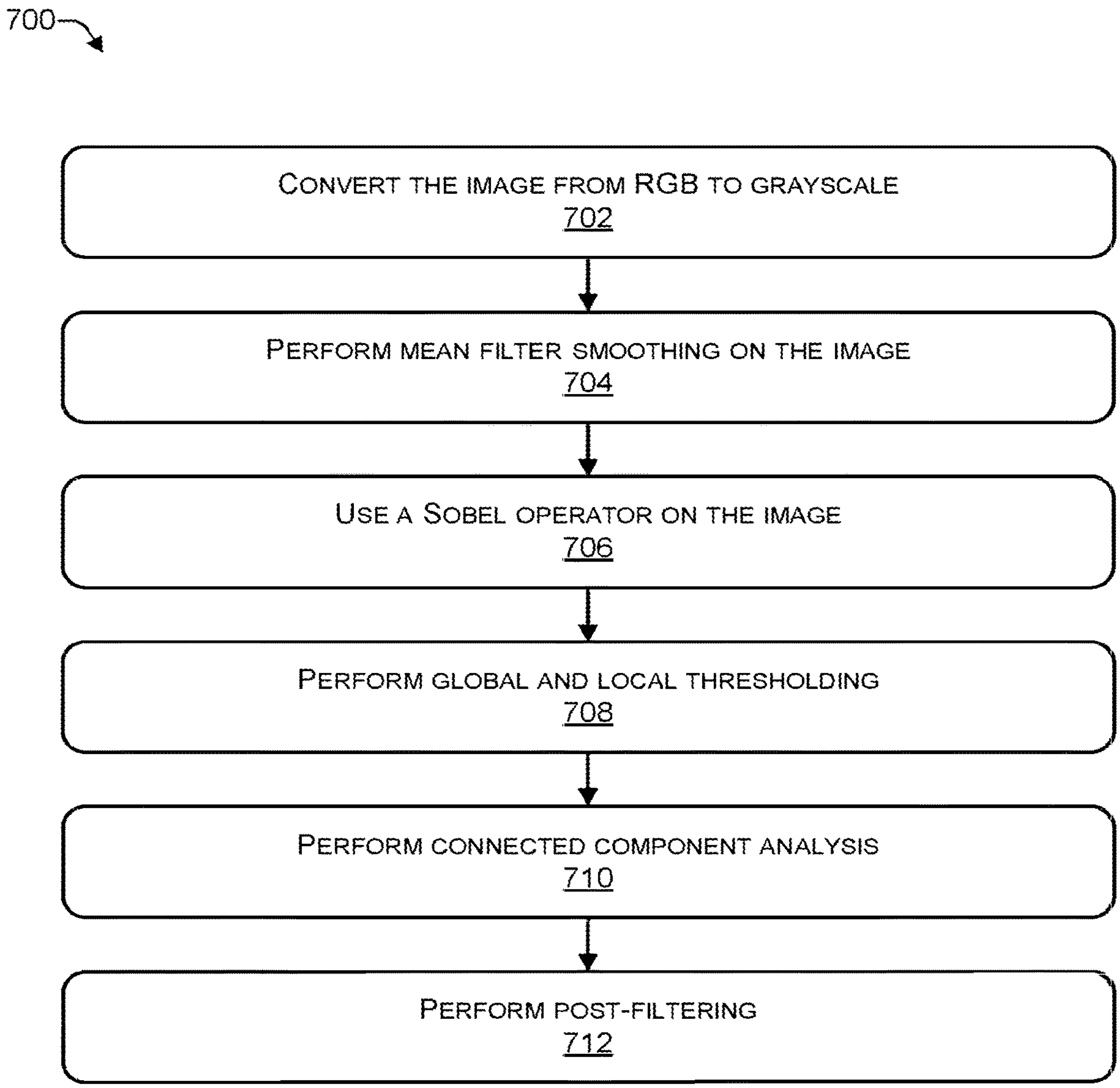
700
Convert the image from RGB to grayscale
702
Perform mean filter smoothing on the image
704
Use a Sobel operator on the image
706
Perform global and local thresholding
708
Perform connected component analysis
710
Perform post-filtering
712

FIG. 7

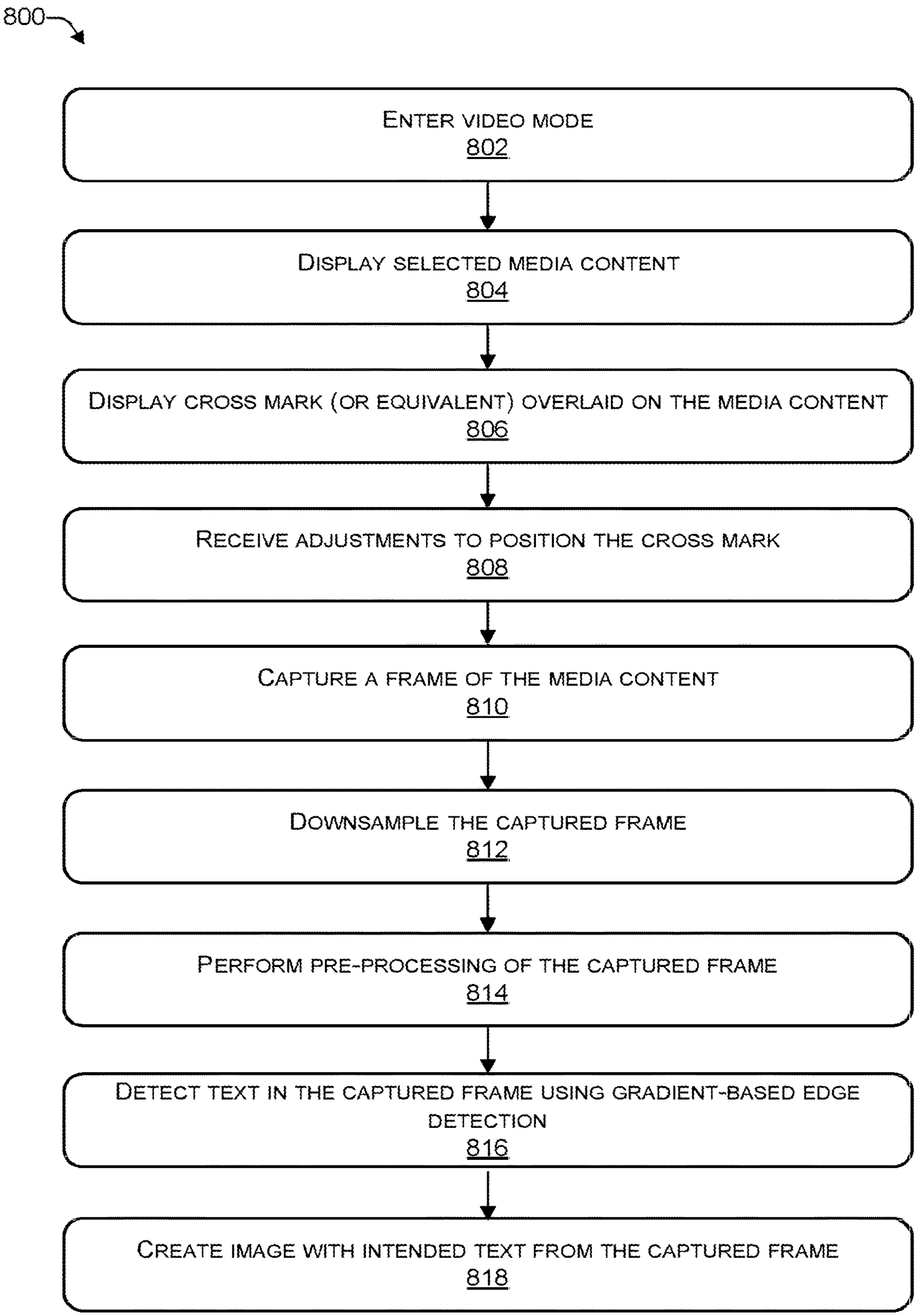
800
Enter video mode
802
Display selected media content
804
Display cross mark (or equivalent) overlaid on the media content
806
Receive adjustments to position the cross mark
808
Capture a frame of the media content
810
Downsample the captured frame
812
Perform pre-processing of the captured frame
814
Detect text in the captured frame using gradient-based edge detection
816
Create image with intended text from the captured frame
818

FIG. 8

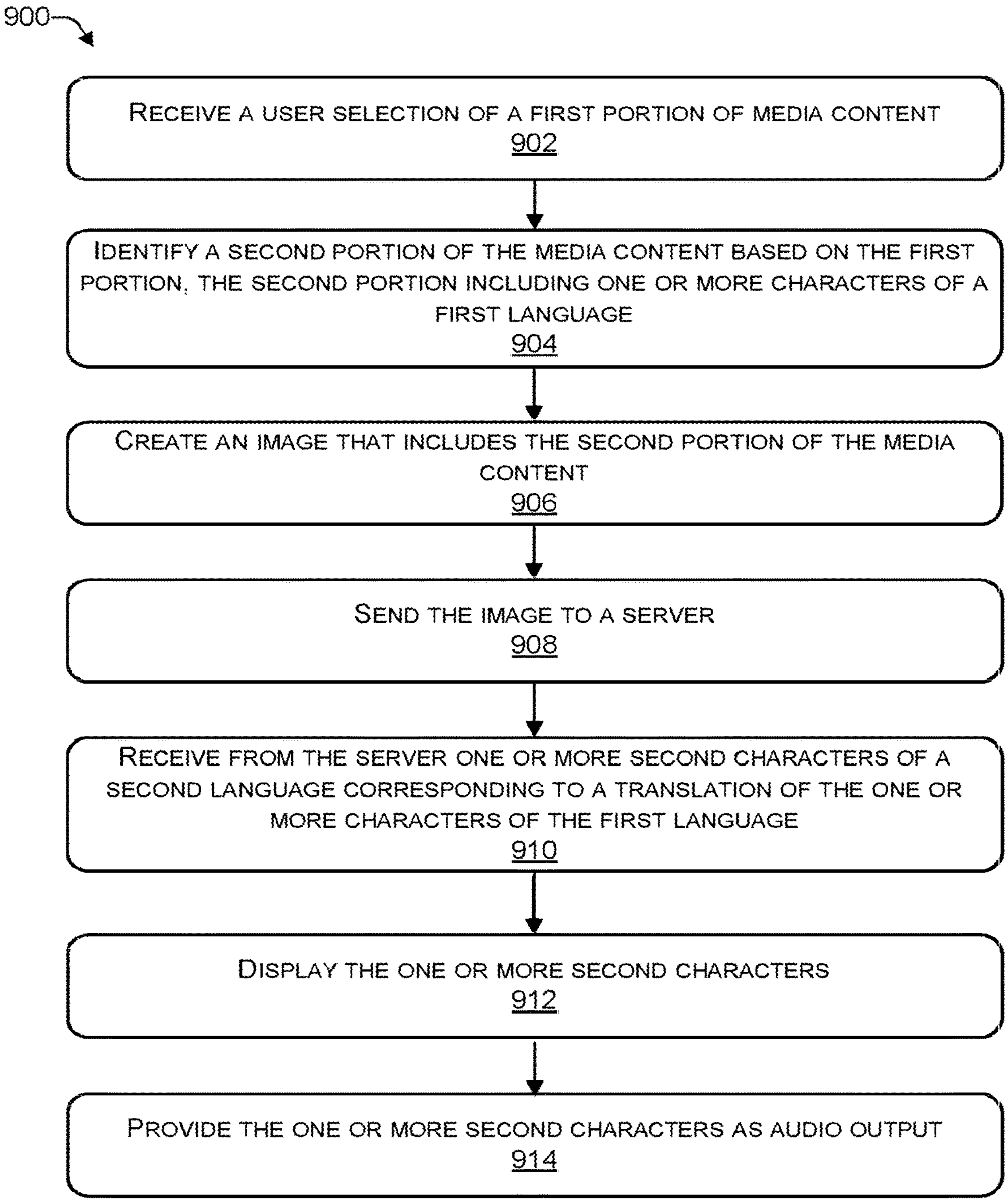
900
RECEIVE A USER SELECTION OF A FIRST PORTION OF MEDIA CONTENT
902
IDENTIFY A SECOND PORTION OF THE MEDIA CONTENT BASED ON THE FIRST PORTION, THE SECOND PORTION INCLUDING ONE OR MORE CHARACTERS OF A FIRST LANGUAGE
904
CREATE AN IMAGE THAT INCLUDES THE SECOND PORTION OF THE MEDIA CONTENT
906
SEND THE IMAGE TO A SERVER
908
RECEIVE FROM THE SERVER ONE OR MORE SECOND CHARACTERS OF A SECOND LANGUAGE CORRESPONDING TO A TRANSLATION OF THE ONE OR MORE CHARACTERS OF THE FIRST LANGUAGE
910
DISPLAY THE ONE OR MORE SECOND CHARACTERS
912
PROVIDE THE ONE OR MORE SECOND CHARACTERS AS AUDIO OUTPUT
914

FIG. 9

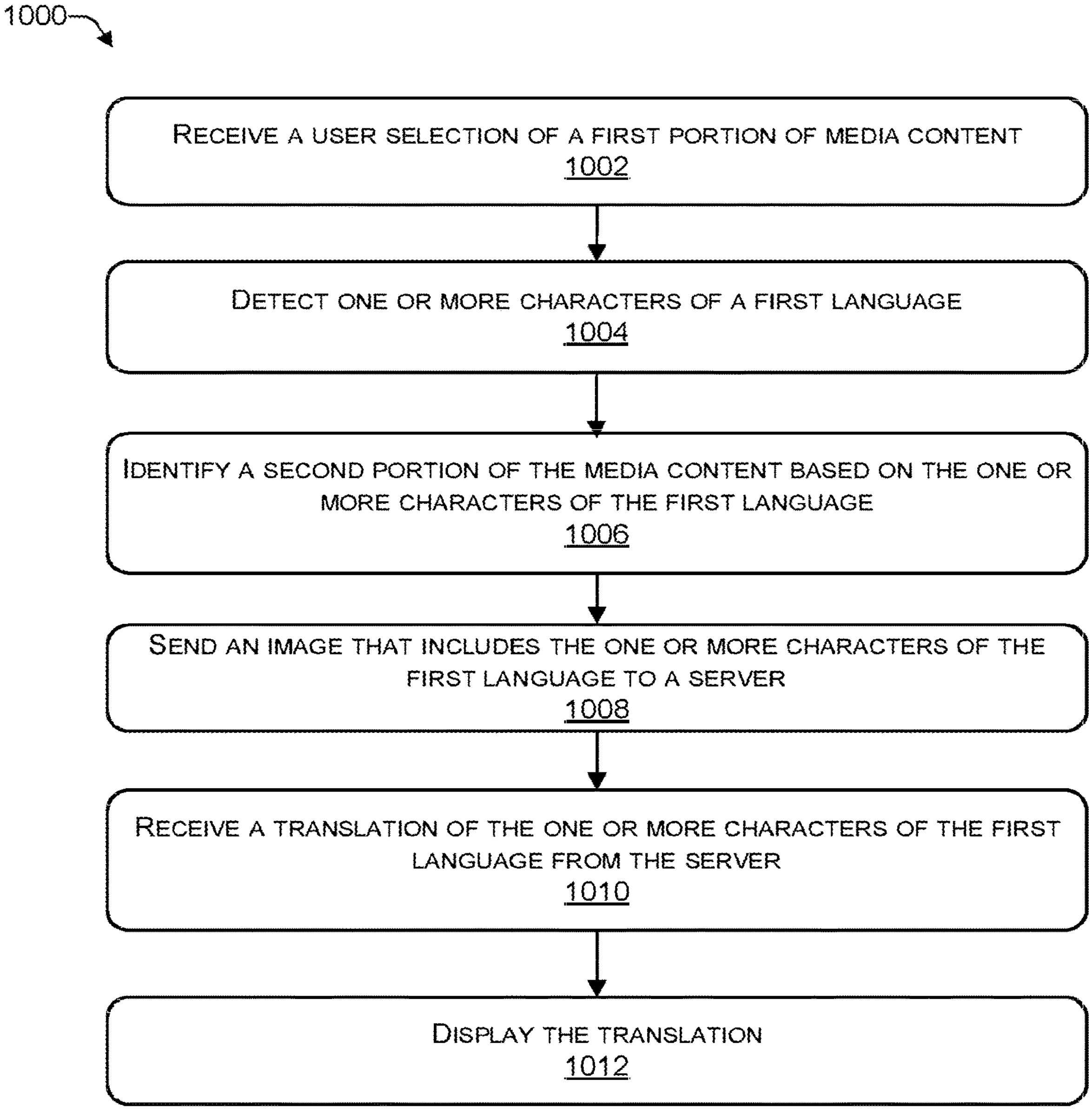
1000
RECEIVE A USER SELECTION OF A FIRST PORTION OF MEDIA CONTENT
1002
DETECT ONE OR MORE CHARACTERS OF A FIRST LANGUAGE
1004
IDENTIFY A SECOND PORTION OF THE MEDIA CONTENT BASED ON THE ONE OR MORE CHARACTERS OF THE FIRST LANGUAGE
1006
SEND AN IMAGE THAT INCLUDES THE ONE OR MORE CHARACTERS OF THE FIRST LANGUAGE TO A SERVER
1008
RECEIVE A TRANSLATION OF THE ONE OR MORE CHARACTERS OF THE FIRST LANGUAGE FROM THE SERVER
1010
DISPLAY THE TRANSLATION
1012

FIG. 10

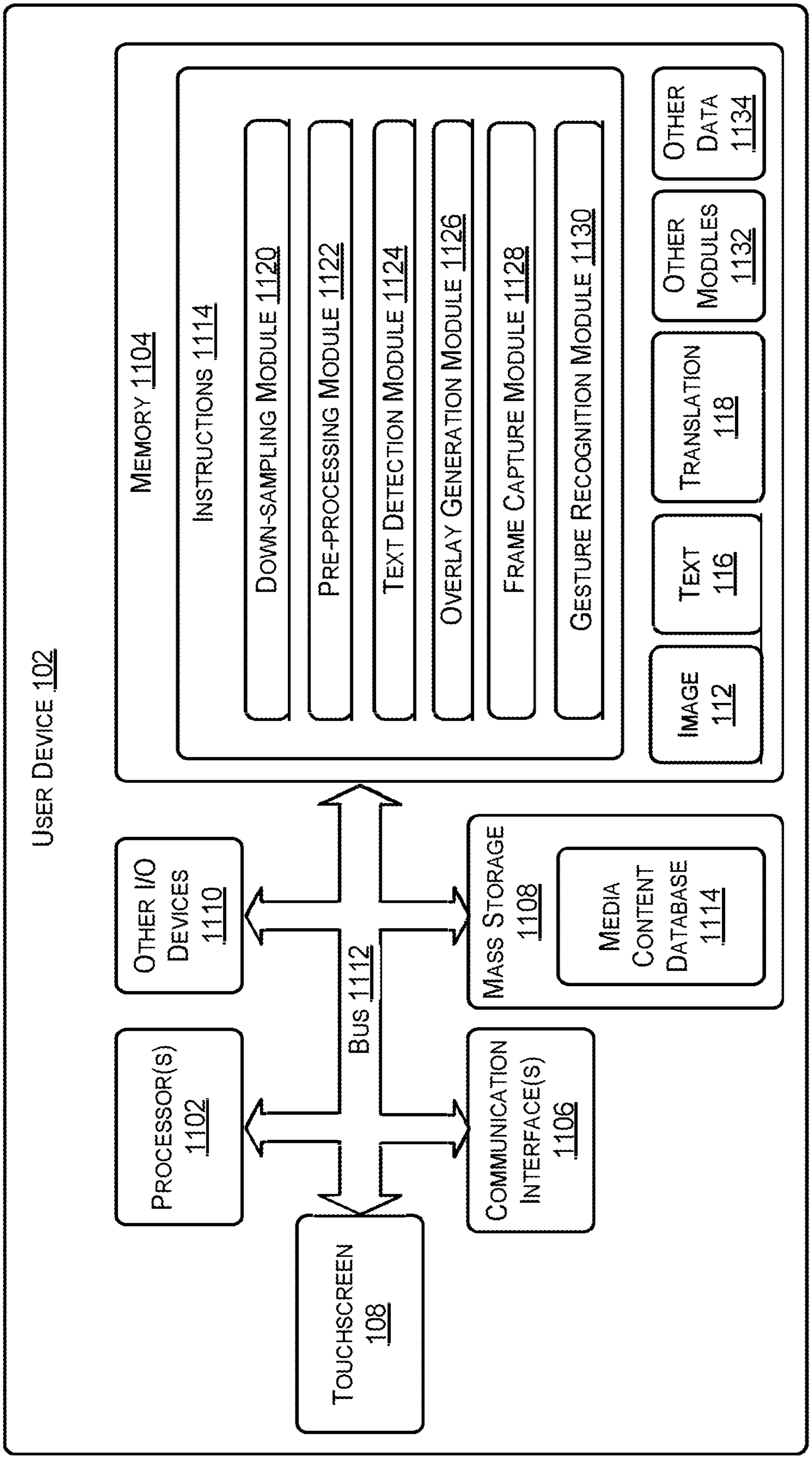
User Device 102
Memory 1104
Instructions 1114
Down-sampling Module 1120
Pre-processing Module 1122
Text Detection Module 1124
Overlay Generation Module 1126
Frame Capture Module 1128
Gesture Recognition Module 1130
Image 112
Text 116
Translation 118
Other Modules 1132
Other Data 1134
Other I/O Devices 1110
Processor(s) 1102
Touchscreen 108
Bus 1112
Mass Storage 1108
Media Content Database 1114
Communication Interface(s) 1106

FIG. 11

TRANSLATING LANGUAGE CHARACTERS IN MEDIA CONTENT

CROSS-REFERENCE TO RELATED APPLICATION(S)

This application is a continuation of U.S. application Ser. No. 17/321,598 filed May 17, 2021, which is a continuation of U.S. application Ser. No. 16/284,256, filed Feb. 25, 2019, now U.S. Pat. No. 11,030,420, which is a continuation of U.S. application Ser. No. 15/010,238, filed on Jan. 29, 2016, now U.S. Pat. No. 10,216,730, which is a continuation of U.S. application Ser. No. 13/227,109, filed on Oct. 19, 2011, now U.S. Pat. No. 9,251,144, the contents of each of which are incorporated herein in their entirety.

BACKGROUND

When learning a new language or when visiting a foreign country, people may desire to translate to/from one language to another language. For example, people may carry a dictionary or phrase book that translates between two or more languages to enable them to communicate in a language that is not their native language ("mother tongue"). Self-contained electronic translators may also enable people to enter characters, words, and phrases for translation. However, books and electronic translators have several limitations. For example, the books and electronic translators are not universal but instead specialize in specific languages. Thus, a user travelling to several different countries may have to carry several different books or electronic translators.

SUMMARY

This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key or essential features of the claimed subject matter; nor is it to be used for determining or limiting the scope of the claimed subject matter.

Some implementations disclosed herein provide techniques and arrangements to enable translating language characters in media content. For example, some implementations receive a user selection of a first portion of media content. Some implementations disclosed herein may, based on the first portion, identify a second portion of the media content. The second portion of the media content may include one or more first characters of a first language. Some implementations disclosed herein may create an image that includes the second portion of the media content and may send the image to a server. Some implementations disclosed herein may receive one or more second characters of a second language corresponding to a translation of the one or more first characters of the first language from the server.

BRIEF DESCRIPTION OF THE DRAWINGS

The detailed description is set forth with reference to the accompanying drawing figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The use of the same reference numbers in different figures indicates similar or identical items or features.

FIG. **1** illustrates an example framework for translating language characters in media content according to some implementations.

FIG. **2** illustrates an example framework for selecting language characters in media content for translation via a tap gesture according to some implementations.

FIG. **3** illustrates an example framework for selecting language characters in media content for translation via a swipe gesture according to some implementations.

FIG. **4** illustrates an example framework for selecting language characters in media content for translation via a circle gesture according to some implementations.

FIG. **5** illustrates an example framework for selecting language characters in media content for translation via a cross mark according to some implementations.

FIG. **6** is a flow diagram of an example process that includes creating an image with intended text according to some implementations.

FIG. **7** is a flow diagram of an example process of pre-processing media content according to some implementations.

FIG. **8** is a flow diagram of an example process that includes creating an image with intended text according to some implementations.

FIG. **9** is a flow diagram of an example process that includes translating language characters in media content according to some implementations.

FIG. **10** is a flow diagram of another example process that includes translating language characters in media content according to some implementations.

FIG. **11** is a block diagram of an example computing device and environment according to some implementations.

DETAILED DESCRIPTION

Translating Language Characters in Media Content

The technologies described herein generally relate to translating language characters in media content. A user may view media content, such as an image or a video, via a user device, such as a computing device. The media content may include characters of a first language. The computing device may be a wireless phone, a tablet computing device, a netbook computing device, a laptop computing device, another type of computing device, or any combination thereof.

The user may select a first portion of the media content that includes at least a portion of the characters of the first language. When the media content is an image, the first portion may be selected using a gesture on a touchscreen of the user device. For example, the gesture may be a tap on the touchscreen, a swipe on the touchscreen, or an approximately circular gesture on the touchscreen. When the media content is a video, the user may position an overlay (e.g., a cross mark, a bounding box, a geometric shape, or other graphic) over the characters of the first language to select the first portion of the media content.

The characters of the first language in the media content may be displayed at any angle between 0 and 360 degrees relative to the touchscreen. For example, the characters of the first language in the media content may be rotated at an angle relative to a bottom of the touchscreen.

Based on the first portion of the media content selected by the user, the user device may identify a second portion of the media content. For example, the first portion may include one or more characters of a word and the second portion may include the entire word. As another example, the first portion may include a character from a first word of a phrase and a character from a second word of the phrase and the second portion may include the entire phrase. The second portion may be referred to as the intended text. As yet another example, the first portion may include one or more characters of a sentence, a phrase, multiple sentences, or a paragraph and the second portion may include the entire sentence, the entire phrase, the multiple sentences, or the paragraph, respectively. Thus, the second portion may include text that the user intends to select, referred to herein as intended text.

The user device may create an image from the media content that includes the second portion. The user device may process the image to reduce a size of the image. The user device may send the image to a remote server via a network. The remote server may extract text including the characters of the first language. The remote server may translate the characters of the first language in the image to a second language. For example, a word, a phrase (e.g., two or more words), a sentence, multiple sentences, or a paragraph may be translated from the first language to the second language to create a translation. The user device may receive the translation from the server and display the translation.

In response to a user selection, the characters in the first language or the characters in the second language may be audibly output. For example, in some implementations, a text-to-speech synthesizer may be provided by the user device to audibly output the characters displayed on the touchscreen of the user device. In other implementations, the server may perform text-to-speech conversion and send an audio file to the user device for play back. The server may create a first audio file corresponding to the text extracted from the image, a second audio file corresponding to the translation, or both. For example, the user device may request the audio file when the user device lacks text-to-speech capabilities. The audio file may be in a compressed format, such as windows media audio (WMA) format or motion picture experts group (MPEG) layer three (mp3) format, or an uncompressed format such as .wav format.

The server may perform one or more searches and return the search results to the user device for display. For example, the server may perform a visual search based on the image, a text-based search based on the characters in the first language, a text-based search based on the characters in the second language, another type of search based on the image, or any combination thereof. In some implementations, the user device may display the search results in response to a user selection.

Framework for Translating Language Characters in Media Content

FIG. **1** illustrates an example of a framework **100** for translating language characters in media content according to some implementations. The framework **100** may be executed by a computing device or other particular machine specifically configured with processor-executable instructions, as discussed additionally below. The framework **100** includes a user device **102** coupled to a server **104** via a network **106**.

The user device **102** may be a wired or wireless computing device, such as a desktop computer, a laptop computer, a netbook computer, a tablet computer, a personal digital assistant (PDA), a camera, a portable music playback device, a wireless phone, another type of computing device, or any combination thereof. The user device **102** may include a touchscreen **108**. The touchscreen **108** may be used to display content and to receive user input. For example, the touchscreen **108** may display a user interface to enable a user to interact with the user device **102**. The user device **102** may include other input devices, such as a camera **134**, a microphone, a keyboard, buttons, potentiometers, and the like. The camera **134** may be integrated with the user device **102** or may be external and coupled to the user device **102**. The user device **102** may include other output devices, such as a speaker to provide audio output.

The network **106** may be implemented as a wired network, a wireless network, a public network, a private network, another type of network, or any combination thereof. For example, the network **106** may include wireless technologies such as code division multiple access (CDMA), global system for mobile (GSM), WiFi® (IEEE 802.11), WiMax®, and the like.

The server **104** may include one or more hardware servers or virtual servers (e.g., in a cloud computing environment, etc.). The server **104** may provide various types of services, such as cloud-based computing services. In some implementations, the services provided by the server **104** may be billable services. For example, when the user device **102** is a mobile phone, the server **104** may provide services based on a subscription or may bill a user on a per transaction basis.

In operation, the user device **102** may use the touchscreen **108** to display media content **110**, such as a picture (e.g., a still image) or a video. For example, the user may use a camera associated with the user device to capture the media content **110**. The user may store the captured media content **110** in a memory of the user device **102**. The user may use the touchscreen **108** to retrieve and display the media content **110** on the touchscreen **108**.

The user may input a gesture, such as a tap, a swipe, a circular gesture, or other types of gesture to select at least a portion of characters of a first language **114** that are displayed in the media content **110**. The user may input the gesture via a user appendage, such as a finger, or via an input instrument, such as a stylus. In response to receiving the gesture input, the user device **102** may create an image **112** that includes characters in the first language **114** based on the media content **110** and the gesture input. As used herein, the term characters may include symbols, numbers, pictograms, sonograms, graphics, and graphemes. The image **112** may be smaller in size than the media content **110**. In some implementations, user device **102** may perform processing to reduce the size of the image **112**, such as by converting the media content **110** from a color image to a grayscale image, reducing a size of the media content **110**, as described in more detail below. The user device **102** may send the image **112** to the server **104**.

The server **104** may receive the image **112** and perform various services based on the image **112**. For example, the server **104** may provide a text extraction module **126** that performs optical character recognition (OCR) on the characters of the first language **114** in the image **112** to extract text **116**. The server **104** may generate a translation **118** of the extracted text **116** using a language translation module **128**. The translation **118** may include one or more characters of a second language **120**. The language translation module **128** may use one or more of a dictionary-based translation, a phrase-based translation, another type of translation, or any combination thereof. For example, when the extracted text **116** comprises a word, the language translation module **128** may use an electronic dictionary to determine the translation **118**. When the extracted text **116** comprises a phrase, the language translation module **128** may use an electronic phrase database to determine the translation **118**.

The server **104** may perform a search using a search engine module **130** based on one or more of the image **112**, the translation **118**, and the extracted text **116**. The server **104** may send one or more of the translation **118** and search results **132** to the user device **102**. In some implementations, one or more of the text extraction module **126**, the language translation module **128**, and the search engine module **130** may operate in parallel (e.g., substantially simultaneously or contemporaneously). For example, the search engine module **130** may perform an image-based search using the image **112** while the text extraction module **126** extracts the text **116**. The search engine module **130** may perform a text-based search using the text **116** while the language translation module **128** creates the translation **118** from the text **116**.

After receiving the translation **118**, the user device **102** may display, on the touchscreen **108**, one or more of the image **112**, the text **116**, and the translation **118**. A user interface of the user device **102** may enable selection of a first speech **122** function that provides audio output corresponding to the text **116**. The user interface of the user device **102** may enable selection of a second speech **124** function that provides audio output corresponding to the translation **118**. In some implementations, in response to the user selecting the first speech **122** function or the second speech **124** function, a text-to-speech module of the user device **102** may provide audio output corresponding to the text **116** or the translation **118**, respectively.

In other implementations, the server **104** may send a first audio file corresponding to the text **116** when the server **104** sends the text **116** to the user device **102** and the server **104** may send a second audio file corresponding to the translation **118** when the server **104** sends the translation **118** to the user device **102**. In these implementations, in response to the user selecting the first speech **122** function or the second speech **124** function, the user device **102** may play back an audio file corresponding to the text **116** or the translation **118**, respectively.

In some implementations, the user device **102** may receive the search results **132** from the server **104** and automatically display the search results **132** on the touchscreen **108**. In other implementations, the user device **102** may receive the search results **132** from the server **104** and, in response to a user selection, display the search results **132** on the touchscreen **108**.

Thus, the user device **102** may enable a user to select a portion of the media content **110** using a gesture, such as a tap, a swipe, or a circular gesture. In response, the user device **102** may create an image **112** from the media content **110** that includes characters of a first language. The image **112** may be sent from the user device **102** to the server **104**. The server **104** may extract the text **116** from the image **112**, determine the translation **118** of the text **116**, and send the text **116** and the translation **118** to the user device **102** for display on the touchscreen **108**. The server **104** may perform a search based on one or more of the image **112**, the text **116**, and the translation **118**. After performing the search, the server **104** may send the search results **132** to the user device **102**. The entire process, from the time the gesture input is received from the user to the time the text **116** and the translation **118** are displayed may take less than three seconds. If the network **106** is capable of relatively fast throughput, the text **116** and the translation **118** may be displayed on the touchscreen **108** less than one second after receiving the gesture input.

The framework **100** may provide several advantages, such as more accurate text extraction by identifying user-intended text, lower bandwidth usage of the network **106** by sending the image **112** that is smaller than the media content **110** to the server **104**, lower latency from when the gesture input is received to when the translation **118** is displayed because the image **112** is smaller than the media content **110**, and longer battery life by having the user device **102** perform fewer computations by using the services provided by the server **104**.

The media content **110**, in the form of an image or a video, may be stored in a memory of the user device **102**. For example, a camera that is integrated into or coupled to the user device **102** may be used to capture the media content **110**. To identify the characters of the first language **114**, the user may select an image mode or a video mode, based on whether the media content **110** is an image or a video. In the image mode, the user may use one of three finger gestures, a tap gesture, a swipe gesture, or an approximately circular gesture, to indicate the intended text, as described in the description of FIGS. **2**, **3**, and **4**.

User Selection of Intended Text Via a Tap Gesture

FIG. **2** illustrates an example framework **200** for selecting language characters in media content for translation via a tap gesture according to some implementations. The tap gesture may be used to select a word or words in a Latin-based language such as English or to select a character or characters in a pictorial-character-based language such as Chinese or Japanese. The media content **110** may include one or more of an image and a video.

The user may use a tap gesture anywhere inside the characters of the first language **114**. In response to the tap, the user device **102** may display a callout window **202** that provides more information about a user selection **206**. For example, the callout window **202** may magnify or otherwise enhance the user selection **206** of a first portion **204** of the media content **110**. The callout window **202** may include a copy of the user selection **206** occluded by a finger (or a stylus) without occluding the intended characters of the first language **114**. The user may make corrective movements while keeping the finger (or the stylus) on the touchscreen **108** until the callout window **202** displays at least a portion of the intended text and then lift the finger (or stylus) to select the first portion **204** of the media content **110**.

In the example illustrated in FIG. **2**, the user has selected the first portion **204** of the media content **110** via a tap gesture. The first portion **204** includes the characters “oll” from the Spanish word “Pollo.” The user device **102** may use text detection to detect a second portion **208** of the media content **110** that includes the entire word “Pollo.”

The user device **102** may create the image **112** that includes the second portion **208** and send the image **112** to the server **104**. The user device **102** may receive, from the server **104**, the text **116** that includes characters of the first language **114**. The user device **102** may receive, from the server **104**, the translation **118** that includes characters of the second language **120**. As illustrated in FIG. **2**, the user device **102** may display the text **116** that includes the characters “Pollo” in the first language **114** (e.g., Spanish) and may display the translation **118** that includes the characters “Chicken” in the second language **120** (e.g., English). The user device **102** may also display the search results **132** that results from an Internet search of one or more of the words “Pollo” and “Chicken.”

Thus, a user can provide the user selection **206** of the first portion **204** of the media content **110** via a tap gesture on the touchscreen **108**. The first portion **204** may include one or more characters of a first language **114**. The user device **102** may identify the second portion **208** based on the first portion **204**. The second portion **208** may include a larger portion of the media content **110** than the first portion **204**. For example, the first portion **204** may include one or more characters of a word while the second portion **208** may include the entire word. The user device **102** may create the image **112** that includes the second portion **208** and send the image **112** to the server **104**. In response, the server **104** may extract the text **116** from the image **112** and determine the translation **118** of the text **116**. The server **104** may send the text **116** and the translation **118** to the user device **102** for display on the touchscreen **108**. The server **104** may perform a search based on one or more of the image **112**, the text **116**, and the translation **118** and send the search results **132** to the user device **102**. The user device **102** may display on the touchscreen **108** one or more of the image **112**, the text **116**, the translation **118**, and the search results **132**.

User Selection of Intended Text Via a Swipe Gesture

FIG. **3** illustrates an example framework **300** for selecting language characters in media content for translation via a swipe gesture according to some implementations. The swipe gesture may be used to select a word, a phrase, or a line of text in a language such as English or to select a one or more characters in a language such as Chinese or Japanese. The media content **110** may include one or more of an image and a video.

The swipe gesture may be input by enabling the user to make corrective movements (e.g., vertical, horizontal, or both) to select a starting point, enabling corrective movements to select an endpoint (e.g., vertical, horizontal, or both), and identifying a user selection **302** in response to the user lifting a finger (or a stylus). The user may use the swipe gesture anywhere inside the characters of the first language **114**. The characters of the first language **114** may not be displayed horizontal relative to a bottom of the touchscreen **108**. For example, the characters of the first language **114** may be at a particular angle (e.g., between 0 and 360 degrees) relative to the touchscreen **108**. As illustrated in FIG. **3**, the characters of the first language **114** may be rotated at an angle relative to the bottom of the touchscreen **108**. The user selection **302** may be received via a swipe gesture that is approximately at the same angle as the characters of the first language **114** relative to the bottom of the touchscreen **108**.

In response to the swipe gesture, the user device **102** may display the callout window **202** that provides more information about the user selection **302**. For example, the callout window **202** may magnify or otherwise enhance the user selection **302** of the first portion **204** of the media content **110**. The callout window **202** may include a copy of the user selection **302** occluded, at least temporarily, by a finger (or a stylus) without occluding the intended characters of the first language **114**.

In the example illustrated in FIG. **3**, the user has selected the first portion **204** of the media content **110** via a swipe gesture. The first portion **204** includes the characters "lo Fr", with the characters "lo" corresponding to the last few letters of the Spanish word "Pollo" and the characters "Fr" corresponding to the first few letters of the Spanish word "Frito." The user device **102** may use text detection to detect a second portion **208** of the media content **110** that includes the entire phrase (or sentence) "Pollo Frito."

The user device **102** may create the image **112** that includes the second portion **208** and send the image **112** to the server **104**. The user device **102** may receive, from the server **104**, the text **116** that includes the characters of the first language **114**. The user device **102** may receive, from the server **104**, the translation **118** that includes the characters of the second language **120**. As illustrated in FIG. **3**, the user device **102** may display the text **116** that includes the characters "Pollo Frito" in the first language **114** (e.g., Spanish) and may display the translation **118** that includes the characters "Fried Chicken" in the second language **120** (e.g., English). The user device **102** may also display the search results **132** that results from an Internet search of one or more of the words "Pollo", "Frito", "Fried", and "Chicken."

A word for word translation of "Pollo Frito" may result in "Chicken Fried" because "Pollo" translates to "Chicken" and "Frito" translates to "Fried." However, in this example, the entire phrase "Pollo Frito" has been translated from Spanish into the corresponding English phrase "Fried Chicken" rather than merely translating each individual word. This example is provided to illustrate that the server **104** may perform (i) a word-for-word translation of a phrase (or a sentence) using a dictionary lookup, (ii) a phrase translation using a phrase database lookup, or both. In some implementations, the server **104** may send the word-for-word translation, the phrase translation, or both to the user device **102**. For example, which translation is sent to the user device **102** may be determined based on a user preference file stored in a memory of the user device **102**. In some implementations, the server **104** may determine whether the word-for-word translation is more accurate or the phrase translation is more accurate and return the translation that the server **104** determines is the more accurate translation.

Thus, a user can provide the user selection **302** of the first portion **204** of the media content **110** via a swipe gesture on the touchscreen **108**. The first portion **204** may include two or more characters of a first language **114**. The user device **102** may identify the second portion **208** based on the first portion **204**. The second portion **208** may include a larger portion of the media content **110** than the first portion **204**. For example, the first portion **204** may include one or more characters of a phrase or a sentence while the second portion **208** may include the entire phrase or sentence. The user device **102** may create the image **112** that includes the second portion **208** and send the image **112** to the server **104**. In response, the server **104** may extract the text **116** of the phrase or sentence from the image **112** and determine the translation **118** of the text **116**. The server **104** may send the text **116** and the translation **118** to the user device **102** for display on the touchscreen **108**. The server **104** may perform a search based on one or more of the image **112**, the text **116**, and the translation **118** and send the search results **132** to the user device **102**. The user device **102** may display on the touchscreen **108** one or more of the image **112**, the text **116**, the translation **118**, and the search results **132**.

User Selection of Intended Text Via a Circular Gesture

FIG. **4** illustrates an example framework **400** for selecting language characters in media content for translation via a circular gesture according to some implementations. As discussed herein, the circular gesture may be a gesture that loosely approximates a circumference of a circle or ellipse. The circular gesture may be used to select a word, a phrase, a line of text, multiple lines of text, or a paragraph. The media content **110** may include one or more of an image and a video.

The circular gesture may be created by using a finger (or stylus) at a starting point and tracing an approximate circumference of a circle on the touchscreen **108** back to the starting point or near the starting point. The user may use the circular gesture anywhere inside the characters of the first language **114**. In response to the circular gesture, the user device **102** may display the callout window **202** that provides more information about a user selection **402**. For example, the callout window **202** may magnify or otherwise enhance the user selection **402** of the first portion **204** of the media content **110**. The callout window **202** may include a copy of the user selection **402**, e.g., an area approximately bounded by the circular gesture.

In the example illustrated in FIG. **4**, the user has selected the first portion **204** of the media content **110** via a circular gesture. The first portion **204** includes the characters "o Fr" and "atas f", with the character "o" corresponding to the last letter of the word "Pollo", the characters "Fr" corresponding to the first few letters of the word "Frito", the characters "atas" corresponding to the last few letters of the word "patatas", and the character "f" corresponding to the first letter of the word "fritas." The user device **102** may use text detection to detect a second portion **208** of the media content **110** that includes the entire phrase (or paragraph) "Pollo Frito con patatas fritas."

The user device **102** may create the image **112** that includes the second portion **208** and send the image **112** to the server **104**. The user device **102** may receive, from the server **104**, the text **116** that includes the characters of the first language **114**. The user device **102** may receive, from the server **104**, the translation **118** that includes the characters of the second language **120**. As illustrated in FIG. **4**, the user device **102** may display the text **116** that includes the characters "Pollo Frito con patatas fritas" in the first language **114** (e.g., Spanish) and may display the translation **118** that includes the characters "Fried Chicken with fried potatoes" in the second language **120** (e.g., English). The user device **102** may also display the search results **132** that results from an Internet search of one or more of the words "Pollo", "Frito", "con", "patatas", "fritas", "Fried", "Chicken", "with", "fried", or "potatoes", or one or more phrases based on the one or more words.

In this example, the entire phrase "Pollo Frito con patatas fritas" is translated from Spanish into the corresponding English phrase "Fried Chicken with fried potatoes" rather than merely translating each individual word. Thus, the server **104** may perform (i) a word-for-word translation of a sentence (or a paragraph) using a dictionary lookup, (ii) a sentence (or a paragraph) translation using a phrase database lookup, or both. In some implementations, the server **104** may send the word-for-word translation, the sentence (or paragraph) translation, or both to the user device **102**. For example, which translation is sent to the user device **102** may be determined based on a user preference file stored in a memory of the user device **102**. In some implementations, the server **104** may determine whether the word-for-word translation is more accurate or the sentence (or paragraph) translation is more accurate and return the translation that the server **104** determines is the more accurate translation.

Thus, a user can provide the user selection **402** of the first portion **204** of the media content **110** via an approximately circular gesture on the touchscreen **108**. The first portion **204** may include two or more characters of a first language **114**. The user device **102** may identify the second portion **208** based on the first portion **204**. The second portion **208** may include a larger portion of the media content **110** than the first portion **204**. For example, the first portion **204** may include one or more characters of a phrase, a sentence, or a paragraph while the second portion **208** may include the entire phrase, sentence or paragraph. The user device **102** may create the image **112** that includes the second portion **208** and send the image **112** to the server **104**. In response, the server **104** may extract the text **116** of the phrase, sentence, or paragraph from the image **112** and determine the translation **118** of the text **116**. The server **104** may send the text **116** and the translation **118** to the user device **102** for display on the touchscreen **108**. The server **104** may perform a search based on one or more of the image **112**, the text **116**, and the translation **118** and send the search results **132** to the user device **102**. The user device **102** may display on the touchscreen **108** one or more of the image **112**, the text **116**, the translation **118**, and the search results **132**.

User Selection of Intended Text Via a Cross Mark

FIG. **5** illustrates an example framework **500** for selecting language characters in media content for translation via a cross mark **504** according to some implementations. The cross mark **504** may be used to select a word, a phrase, a line of text, a sentence, or a paragraph (e.g., multiple sentences) in a language such as English or to select one or more characters in a language such as Chinese or Japanese. The media content **110** may include one or more of an image and a video. In some implementations, the tap gesture, the swipe gesture, and the circular gesture may be used when the media content **110** includes an image while the cross mark **504** may be used when the media content **110** includes video content. In other implementations, one or more of the tap gesture, the swipe gesture, the circular gesture, and the cross mark **504** may be used to provide the user selection.

A cross mark **504** may be overlaid over a portion of the media content **110** to enable the user to provide a user selection **502**. The user device **102** may display the callout window **202** that provides more information about the user selection **502**. For example, the callout window **202** may magnify or otherwise enhance the user selection **502** of the first portion **204** of the media content **110**. The callout window **202** may include a copy of the user selection **502**. The user may input horizontal and vertical adjustments to position the cross mark **504** near or over one or more of the characters in the first language **114**. For example, the horizontal and vertical adjustments may be made by swiping gestures via a finger (or a stylus) or by using arrow keys displayed on the touchscreen **108**.

Once the cross mark **504** is positioned to the satisfaction of the user (e.g., the callout window **202** displays the word, phrase, sentence, or paragraph that the user desires to select), the user may create the user selection **502** by performing an action on a user interface of the user device **102**. For example, once the cross mark **504** is satisfactorily positioned, the user may tap a location where the cross mark is displayed on the touch screen **108** to create the user selection **502**. As another example, the user may select an appropriate key or user interface control to create the user selection **502**. The user selection **502** may be based on which characters in the first language **114** are in close proximity to or overlaid by the cross mark **504**.

In the example illustrated in FIG. **5**, the first portion **204** includes the characters "llo Fr", with the characters "llo" corresponding to the last few letters of the Spanish word "Pollo" and the characters "Fr" corresponding to the first few letters of the Spanish word "Frito." The user device **102** may use text detection to detect a second portion **208** of the media content **110** that includes the entire phrase (or sentence) "Pollo Frito."

The user device **102** may create the image **112** that includes the second portion **208** and send the image **112** to the server **104**. The user device **102** may receive, from the server **104**, the text **116** that includes the characters of the first language **114**. The user device **102** may receive, from the server **104**, the translation **118** that includes the characters of the second language **120**. As illustrated in FIG. **3**, the user device **102** may display the text **116** that includes the characters "Pollo Frito" in the first language **114** (e.g., Spanish) and may display the translation **118** that includes the characters "Fried Chicken" in the second language **120** (e.g., English). The user device **102** may also display the search results **132** that results from an Internet search of one or more of the words "Pollo", "Frito", "Fried", and "Chicken."

The server **104** may perform (i) a word-for-word translation of a phrase (or a sentence) using a dictionary lookup, (ii) a phrase translation using a phrase database lookup, or both. In some implementations, the server **104** may send the word-for-word translation, the phrase translation, or both to the user device **102**. For example, which translation is sent to the user device **102** may be determined based on a user preference file stored in a memory of the user device **102**. In some implementations, the server **104** may determine whether the word-for-word translation is more accurate or the phrase translation is more accurate and return the translation that the server **104** determines is the more accurate translation.

In some implementations, the user may select a bounding box (e.g., a rectangular shaped box) or other geometric shape (e.g., a circle, a triangle, a square and the like) that is overlaid on the media content **110** instead of the cross mark **504**. The width and height of the bounding box may be adjusted with corrective finger movements. The bounding box may be positioned similar to the cross mark **504** to provide the user selection **502**.

Thus, a user may provide the user selection **502** of the first portion **204** of the media content **110** by positioning the cross mark **504** to overlay a portion of the media content **110** that is displayed on the touchscreen **108**. The first portion **204** may include two or more characters of a first language **114**. The user device **102** may identify the second portion **208** based on the first portion **204**. The second portion **208** may include a larger portion of the media content **110** than the first portion **204**. For example, the first portion **204** may include one or more characters of a phrase or a sentence while the second portion **208** may include the entire phrase or sentence. The user device **102** may create the image **112** that includes the second portion **208** and send the image **112** to the server **104**. In response, the server **104** may extract the text **116** of the phrase or sentence from the image **112** and determine the translation **118** of the text **116**. The server **104** may send the text **116** and the translation **118** to the user device **102** for display on the touchscreen **108**. The server **104** may perform a search based on one or more of the image **112**, the text **116**, and the translation **118** and send the search results **132** to the user device **102**. The user device **102** may display on the touchscreen **108** one or more of the image **112**, the text **116**, the translation **118**, and the search results **132**.

Example Processes

FIG. **6** is a flow diagram of an example process **600** that includes creating an image with intended text according to some implementations. FIG. **7** is a flow diagram of an example process **700** of pre-processing media content according to some implementations. FIG. **8** is a flow diagram of an example process **800** that includes creating an image with intended text according to some implementations. FIG. **9** is a flow diagram of an example process **900** that includes translating language characters in media content according to some implementations. FIG. **10** is a flow diagram of an example process **1000** that includes translating language characters in media content according to some implementations. In the flow diagrams of FIGS. **7**, **8**, **9** and **10**, each block represents one or more operations that can be implemented in hardware, software, or a combination thereof. In the context of software, the blocks represent computer-executable instructions that, when executed by one or more processors, cause the processors to perform the recited operations. Generally, computer-executable instructions include routines, programs, objects, modules, components, data structures, and the like that perform particular functions or implement particular abstract data types. The order in which the blocks are described is not intended to be construed as a limitation, and any number of the described operations can be combined in any order and/or in parallel to implement the processes. For discussion purposes, the processes **700**, **800**, **900**, and **1000** are described with reference to one or more of the frameworks **100**, **200**, **300**, **400**, and **500**, described above, although other models, frameworks, systems and environments may implement these processes.

At block **602**, a user device may enter a still image mode. For example, the user may interact with a user interface of the user device **102** to instruct the user device **102** to enter into the still image mode used to display or render still imagery (e.g., photographs, drawings, etc.). In some implementations, the still image mode may enable the user to provide the user selection via the tap gesture (e.g., the user selection **206**), the swipe gesture (e.g., the user selection **302**), or the circle gesture (e.g., the user selection **402**).

At block **604**, media content may be loaded. For example, the user device **102** may load the media content **110** in response to a user selection of the media content **110**. The media content **110** may include one or more of an image (e.g., media content in a format such as RAW, JPEG, TIFF or the like) or a video (e.g., media content in an MPEG format or the like). The media content **110** may be created at the user device **102** via the camera **134** that is integrated into or coupled to the user device **102** or the media content **110** may be received from another device via the network **106**. The media content **110** may be stored in and retrieved from a memory of the user device **102**.

At block **606**, the media content may be down-sampled to reduce the file size of the image (e.g., fewer bytes of data). For example, the user device **102** may down-sample the media content **110** to a resolution of approximately 640×480 pixels or other size. The down-sampling may be performed to improve an efficiency of the pre-processing at block **608**.

At block **608**, the media content may be pre-processed. For example, the user device **102** may pre-process the media content **110** based on the user selection **206**. The pre-processing is described in more detail in FIG. **7**.

At block **610**, a user selection of a portion of the media content is received. For example, the user device **102** may receive the user selection selecting the first portion **204** of the media content **110**.

At block **612**, text in the media content may be detected based on the user selection. For example, the user device **102** may identify the second portion **208** (e.g., the intended text) of the media content **110** based on the first portion **204** of the media content **110**.

At block **614**, a determination may be made whether to adjust the user selection. For example, if the user is determined to be dissatisfied with the first portion **204** displayed in the callout window **202**, the user may provide another user selection **206** at block **610**. If the user is determined to be satisfied with the first portion **204** displayed in the callout window **202**, the process may proceed to block **616**.

At block **616**, edge-based text detection may be performed. For example, the user device **102** may perform edge-based text detection to detect the second portion **208** (e.g., the intended text) based on the user selection **206** (e.g., the first portion **204**). Edge-based text detection using the first portion **204** may be used to locate bounds of the second portion **208** (e.g., the intended text).

In edge-based text detection, user input, in the form of the user selection **206**, may be represented by positions p_l(left), p_r(right), p_t(top), and p_b(bottom). For a tap gesture, $p_l=p_r$ while $p_t=p_b$, and for a swipe gesture $p_t=p_b$. The output of the edge-based text detection is the second portion **208** that includes the intended box. The second portion **208** may be described using the positions bb_l(left), bb_r(right), bb_t(top), and bb_b(bottom). The abbreviation bb refers to bounding box.

The term gr is used to represent a ratio of a minimum gap between words or characters to height. For example, for English and other Latin-based languages gr=0.2 may be used while for pictorial characters such as Chinese or Japanese, gr=0 may be used. The term L may be used to represent a fixed length of a horizontal line segment. In the example below, L=32 for illustration purposes. In some implementations, L may have a value different from 32. Initially, $bb_t=p_t$, $bb_b=p_b$, $bb_l=p_l$, and $bb_r=p_r$, e.g., the first portion **204** is used as the starting point for the second portion **208**.

The top and bottom positions of the second portion **208** may be located by moving a horizontal line segment, with the length set as the max of p_r-p_l and L, starting from the top point $((p_l+p_r)/2, p_t)$ or bottom point $((p_l+p_r)/2, p_b)$, vertically upwards (decrease bb_t) and downwards (increase bb_b), respectively, until a non-edge horizontal line segment is encountered, which contains no edge pixels of scanned connected components.

The left and right positions of the second portion **208** may be located by moving a vertical line segment, with the length set as the bb_b-bb_t starting from the left point $(p_l, (bb_b+bb_t)/2)$ or right point $(p_r, (bb_b+bb_t)/2)$, horizontally leftwards (decrease bb_l) and rightwards (increase bb_r), respectively, until more than consecutive $(bb_b-bb_t)*gr$ non-edge vertical line segments are collected.

In the case of a word with ascending or descending portions, bb_t and bb_b may be baseline positions rather than the desired border line positions. The top and bottom positions of the second portion **208** may be refined further by moving a horizontal line segment, with the length set to bb_r-bb_l, vertically upwards (decrease bb_t) and downwards (increase bb_b), respectively, until a non-edge horizontal line segment is encountered.

At block **618**, an image may be created with the intended text from the media content based on the user selection. For example, the user device **102** may create the image **112** that includes the second portion **208** (e.g., the intended text) based on the user selection (e.g., the first portion **204**). In some implementations, when the image is small (e.g., width or height is less than 40 pixels), the corresponding original image (e.g., before down-sampling) is sent to the server **104** instead of the down-sampled image.

FIG. **7** is a flow diagram of an example process **700** of pre-processing media content according to some implementations. For example, the media content may be preprocessed in a still-image mode to obtain an edge map for subsequent text detection.

At block **702**, the image may be converted from a red-green-blue (RGB) image to a grayscale image. For example, the user device **102** may convert the image **112** from a color (e.g., RGB) image to a grayscale image.

At block **704**, mean filter smoothing may be performed on the image. For example, the user device **102** may apply a 3×3 mean filter to the image **112** for image smoothing and noise removal.

At block **706**, a Sobel operator may be used on the image. For example, the user device **102** may use a Sobel operator to calculate a gradient for each pixel. A gradient magnitude for each pixel may be approximated using a maximum of horizontal gradients and vertical gradients. An edge map may be initialized based on gradient features by using the non-maximum suppression to remove most non-edge pixels. The integral image of gradient features may be precalculated for performing global and local thresholding at block **708**.

At block **708**, global and local thresholding may be performed. The global thresholding may be performed by the user device **102** to remove non-edge pixels with very small gradient magnitude by using a conservative global threshold. For local thresholding, hysteresis thresholding may be used, in which two (e.g., a high and a low) local thresholds are calculated from the integral image. Consequently, both strong and weak edges can be preserved while non-edge pixels near an edge can be removed. After thresholding, a binary image morphology operation called bridge may be applied to make the edge map more connective.

At block **710**, connected component analysis may be performed. Connected component analysis is an algorithmic application of graph theory, where subsets of connected components are uniquely labeled based on a given heuristic to detect connected regions in binary digital images.

At block **712**, post-filtering may be performed. For example, the user device **102** may perform post-filtering to remove non-text connected components by using geometry information such as an area and aspect ratio of each connected component.

FIG. **8** is a flow diagram of an example process **800** that includes creating an image with intended text according to some implementations.

At block **802**, a user device may enter a video mode. For example, the user may interact with a user interface of the user device **102** to instruct the user device **102** to enter into the video image mode used to display or render video imagery. In some implementations, the video image mode may enable the user to provide the user selection **502** by positioning a cross mark (e.g., the cross mark **504**) or a bounding box to approximately overlay the first portion **204** of the media content **110**.

At block **804**, media content may be displayed. For example, the user device **102** may display the media content **110** on the touchscreen **108** in response to a user selection of the media content **110**. The media content **110** may include one or more of an image (e.g., media content in a format such as RAW, JPEG, TIFF or the like) or a video (e.g., media content in an MPEG format or the like). The media content **110** may be created at the user device **102** via a camera that is integrated into or coupled to the user device **102** or the media content **110** may be received from another device via the network **106**. The media content **110** may be stored in and retrieved from a memory of the user device **102**.

At block **806**, a cross mark (or equivalent) may be displayed as an overlay on the media content. For example, the cross mark **504**, a bounding box, or other geometric shape (e.g., a circle, a square, a triangle etc.) may be displayed on the touchscreen **108** as an overlay on the media content **110**.

At block **808**, adjustments to position the cross mark may be received. For example, the user may position the cross mark **504** (or equivalent) using one or more tap gestures, one or more swipe gestures, via arrow keys of the user device **102**, via a user interface displayed on the touchscreen **108**, another type of input mechanism, or any combination thereof.

At block **810**, a frame of the media content may be captured. For example, when the media content **110** is video content, the user may position the cross mark **504** and perform an action to indicate the user selection **502**. To illustrate, the user may position the cross mark **504** and perform a tap gesture (or other user interface input) on the touchscreen to provide the user selection. In response, the user device **102** may capture a frame of the media content **110**.

At block **812**, the captured frame may be down-sampled. For example, the user device **102** may down-sample the captured frame to a resolution of approximately 640×480 pixels or another resolution, which may be of a smaller file size than an initial file size.

At block **814**, the captured frame may be pre-processed. For example, the user device **102** may pre-process the captured frame of the media content **110** based on the user selection. The pre-processing is described in more detail above with reference to FIG. **7**. In some implementations (e.g., for gradient-based text detection), one or more of the blocks **702**, **704**, or **706** of FIG. **7** may be performed.

At block **816**, text in the captured frame may be detected using gradient-based text detection. For example, the user device **102** may perform gradient-based text detection to detect the second portion **208** (e.g., the intended text) based on the user selection **502** (e.g., the first portion **204**). Gradient-based text detection may use the first portion **204** to locate bounds of the second portion **208** (e.g., the intended text).

In gradient-based text detection, the user may use a cross mark, bounding box or other graphical overlay to provide the user selection **502**. The user selection **502** may be represented by positions p_l(left), p_r(right), p_t(top), and p_b(bottom). The output of the gradient-based text detection may be the second portion **208** that includes the intended box. The second portion **208** may be described using the positions bb_l(left), bb_r(right), bb_t(top), and bb_b(bottom). The abbreviation bb refers to bounding box.

The term gr is used to represent a ratio of a minimum gap between words or characters to height. For example, for English and other Latin-based languages gr=0.2 may be used while for pictorial characters such as Chinese or Japanese, gr=0 may be used. The term thr may be used to represent an adaptive threshold. The term L may be used to represent a fixed length of a horizontal line segment. In the example below, L=32 for illustration purposes. In some implementations, L may have a value different from 32. Initially, $bb_t=p_t$, $bb_b=p_b$, $bb_l=p_l$, and $bb_r=p_r$, e.g., the first portion **204** may be used as the starting point for the second portion **208**.

The top and bottom positions of the second portion **208** may be located by moving a horizontal line segment, with the length set as the max of p_r-p_l and L, starting from the top point $((p_l+p_r)/2, p_t)$ or bottom point $((p_l+p_r)/2, p_b)$, vertically upwards (decrease bb_t) and downwards (increase bb_b), respectively, until a maximum gradient magnitude on the current line segment is less than the adaptive threshold thr. The adaptive threshold thr may be related to the mean value of gradient magnitudes accumulated from scratch to the current horizontal line segment.

In some implementations, a more robust method to extract the top and bottom positions called convex hull technique may be used. In the convex hull technique, the difference of maximum and minimum gradient magnitude values on each horizontal line segment may be extracted as a feature. As the line segment moves upwards and downwards starting from an initial point, a feature profile can be formed incrementally. The top and bottom positions may correspond to the positions with the two steepest slopes of the feature profile. Given the feature profile, a convex hull may be constructed incrementally, from which the final top and bottom positions may be localized with an appropriate stopping criterion.

The left and right positions of the second portion **208** may be located by moving a vertical line segment, with the length set as the bb_b-bb_t starting from the left point $(p_l, (bb_b+bb_t)/2)$ or right point $(p_r, (bb_b+bb_t)/2)$, horizontally leftwards (decrease bb_l) and rightwards (increase bb_r), respectively, until more than consecutive (bb_b-bb_t)*gr vertical line segments, which satisfy that the maximum gradient magnitude of each vertical line segment is less than the adaptive threshold thr, are collected. The adaptive threshold thr may be related to the mean value of gradient magnitudes accumulated during the scanning using horizontal line segments.

In the case of a word with ascending or descending portions, bb_t and bb_b may be baseline positions rather than the desired border line positions. The top and bottom positions of the second portion **208** may be refined further by moving a horizontal line segment, with the length set to bb_r-bb_l, vertically upwards (decrease bb_t) and downwards (increase bb_b), respectively, until a horizontal line segment, which satisfies that the maximum gradient magnitude of horizontal line segment is less than the adaptive threshold thr, is encountered.

At block **818**, an image may be created with the intended text from the captured frame. For example, the user device **102** may create the image **112** that includes the second portion **208** (e.g., the intended text) based on the user selection (e.g., the first portion **204**).

FIG. **9** is a flow diagram of an example process **900** that includes translating language characters in media content according to some implementations.

At block **902**, a user selection of a first portion of media content is received. For example, the user device **102** may receive the user selection **206** of the first portion **204** of the media content **110**.

At block **904**, a second portion of the media content is identified based on the first portion. The second portion may include one or more characters of a first language. For example, the user device **102** may identify the second portion **208** based on the first portion **204**. The second portion **208** includes one or more characters in the first language **114**. The user device **102** may identify the second portion **208** using edge-based text detection, gradient-based text detection, another type of text detection, or any combination thereof. The second portion **208** may be larger in size than the first portion **204**.

At block **906**, an image may be created that includes the second portion of the media content. For example, the user device **102** may create the image **112** from the media content

110. The image **112** may be smaller in size (e.g., have fewer bytes of data) than the media content **110**.

At block **908**, the image may be sent to a server. For example, the user device **102** may send the image **112** to the server **104** via the network **106**.

At block **910**, one or more second characters of a second language corresponding to a translation of the one or more characters of the first language may be received from the server.

At block **912**, the one or more second characters may be displayed. For example, the user device **102** may receive one or more characters of the second language **120** from the server **104** and display the one or more second characters of the second language **120** on the touchscreen **108**.

At block **914**, the one or more characters may be provided as audio output. For example, the one or more second characters of the second language **120** may be provided as audio output in response to the user selecting the speech function **124**. In some implementations, the one or more second characters of the second language **120** may be provided as audio output via text-to-speech function of the user device **102**. In other implementations, the one or more second characters of the second language **120** may be provided as audio output by playing back an audio file received from the server **104** along with the translation **118**. In some implementations, the user device **102** may receive the search results **132** from the server **104**. The user device **102** may display the search results **132** on the touchscreen **108** automatically, based on a user profile stored at the user device **102**, or in response to a user instruction.

FIG. **10** is a flow diagram of an example process **1000** that includes translating language characters in media content according to some implementations.

At block **1002**, a user selection of a first portion of media content is received. For example, the user device **102** may receive the user selection **206** of the first portion **204** of the media content **110**.

At block **1004**, one or more characters of a first language are detected.

At block **1006**, a second portion of the media content is identified based on the one or more characters of the first language. For example, the user device **102** may identify the second portion **208** based on the first portion **204**. The second portion **208** includes one or more characters in the first language **114**. The user device **102** may identify the second portion **208** using edge-based text detection, gradient-based text detection, another type of text detection, or any combination thereof. The second portion **208** may be larger in size (e.g., encompassing more characters, symbols, etc.) than the first portion **204**.

At block **1008**, an image that includes the second portion of the media content is sent to a server. For example, the user device **102** may create the image **112** from the media content **110** and send the image **112** to the server **104**. The image **112** may be smaller in size (e.g., have fewer bytes of data) than the media content **110**.

At block **1010**, a translation of the one or more characters of the first language may be received from the server.

At block **1012**, the translation may be displayed. For example, the user device **102** may receive the translation **118** corresponding to the characters of the first language **114** from the server **104** and display the translation **118** on the touchscreen **108**. In some implementations, the user device **102** may receive the search results **132** from the server **104**. The user device **102** may display the search results **132** on

the touchscreen **108** automatically, based on a user profile stored at the user device **102**, or in response to a user instruction.

Example Computing Device and Environment

FIG. **11** illustrates an example configuration of the user device **102** and an environment that can be used to implement the modules and functions of the user device **102**. The user device **102** may include at least one processor **1102**, a memory **1104**, communication interfaces **1106**, a touchscreen **108**, other input/output (I/O) devices **1110**, and one or more mass storage devices **1108**, able to communicate with each other, such as via a system bus **1112** or other suitable connection.

The processor **1102** may be a single processing unit or a number of processing units, all of which may include single or multiple computing units or multiple cores. The processor **1102** can be implemented as one or more microprocessors, microcomputers, microcontrollers, digital signal processors, central processing units, state machines, logic circuitries, and/or any devices that manipulate signals based on operational instructions. Among other capabilities, the processor **1102** can be configured to fetch and execute computer-readable instructions stored in the memory **1104**, mass storage devices **1108**, or other computer-readable media.

Memory **1104** and mass storage devices **1108** are examples of computer storage media for storing instructions which are executed by the processor **1102** to perform the various functions described above. For example, memory **1104** may generally include both volatile memory and non-volatile memory (e.g., RAM, ROM, or the like). Further, mass storage devices **1108** may generally include hard disk drives, solid-state drives, removable media, including external and removable drives, memory cards, flash memory, floppy disks, optical disks (e.g., CD, DVD), a storage array, a network attached storage, a storage area network, or the like. Both memory **1104** and mass storage devices **1108** may be collectively referred to as memory or computer storage media herein, and may be capable of storing computer-readable, processor-executable program instructions as computer program code that can be executed by the processor **1102** as a particular machine configured for carrying out the operations and functions described in the implementations herein.

Computer-readable media may include, at least, two types of computer-readable media, namely computer storage media and communication media. Computer storage media may include volatile and non-volatile, removable, and non-removable media implemented in any method or technology for storage of information, such as computer readable instructions, data structures, program modules, or other data. The system memory **1104**, the removable storage and the non-removable storage are all examples of computer storage media. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD), or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other non-transmission medium that can be used to store the desired information and which can be accessed by the computing device **102**. Any such computer storage media may be part of the computing device **102**. Moreover, the computer-readable media may include computer-executable instructions that, when executed by the processor(s) **1102**, perform various functions and/or operations described herein.

In contrast, communication media may embody computer-readable instructions, data structures, program modules, or other data in a modulated data signal, such as a carrier wave, or other transmission mechanism. As defined herein, computer storage media does not include communication media.

The user device **102** may also include one or more communication interfaces **1106** for exchanging data with other devices, such as via a network, direct connection, or the like, as discussed above. The communication interfaces **1106** can facilitate communications within a wide variety of networks and protocol types, including wired networks (e.g., LAN, cable, etc.) and wireless networks (e.g., WLAN, cellular, satellite, etc.), the Internet and the like. Communication interfaces **1106** can also provide communication with external storage (not shown), such as in a storage array, network attached storage, storage area network, or the like. The mass storage **1108** may include a media content database **1114** for storing media content, such as the media content **110**.

A touchscreen **108** may be included in some implementations for displaying output and for receiving user input. For example, the touchscreen **108** may be used to display media content from the media content database **1114**, as well as other items, such as the text **116**, the translation **118**, the search results **132**, a user interface, and the like. The touchscreen **108** may also be capable of receiving user input via gestures, such as a tap gesture, a swipe gesture, or a circle gesture. Other I/O devices **1100** may be devices that receive various inputs from a user and provide various outputs to the user, and may include a keyboard, a remote controller, a mouse, a printer, audio input/output devices, and so forth.

Memory **1104** may include modules and components for performing functions related to translating image characters in media content according to the implementations herein. In the illustrated example, memory **1104** includes a down-sampling module **1120**, a pre-processing module **1122**, a text detection module **1124**, an overlay generation module **1126**, a frame capture module **1128**, and a gesture recognition module **1130**. The down-sampling **1120** may be configured to down-sample an image, such as the image **112**. The pre-processing module **1122** may be configured to perform pre-processing, such as the pre-processing described in FIG. **7**. The text detection module **1124** may be configured to detect text in an image using edge-based text detection, gradient-based text detection, another type of text detection, or any combination thereof. The frame capture module **1128** may be configured to capture a frame of a video. The gesture recognition module **1130** may be configured to recognize gesture input, such as a tap gesture, a swipe gesture, or a circle gesture. The gesture input may be received by the user interacting with the touchscreen **108** using an appendage, such as a finger, or using a stylus.

The memory **1104** may include other modules **1132** and other data **1134**. The memory **1104** may include the image **112**. The memory **1104** may also include the text **116** and the translation **118** received from the server **104**.

The example systems and computing devices described herein are merely examples suitable for some implementations and are not intended to suggest any limitation as to the scope of use or functionality of the environments, architectures and frameworks that can implement the processes, components and features described herein. Thus, implementations herein are operational with numerous environments or architectures, and may be implemented in general purpose and special-purpose computing systems, or other devices having processing capability. Generally, any of the functions described with reference to the figures can be implemented using software, hardware (e.g., fixed logic circuitry) or a combination of these implementations. The term "module," "mechanism" or "component" as used herein generally represents software, hardware, or a combination of software and hardware that can be configured to implement prescribed functions. For instance, in the case of a software implementation, the term "module," "mechanism" or "component" can represent program code (and/or declarative-type instructions) that performs specified tasks or operations when executed on a processing device or devices (e.g., CPUs or processors). The program code can be stored in one or more computer-readable memory devices or other computer storage devices. Thus, the processes, components and modules described herein may be implemented by a computer program product.

Although illustrated in FIG. **11** as being stored in memory **1104** of user device **102**, the modules **1120**, **1122**, **1124**, **1126**, **1128**, and **1130**, or portions thereof, may be implemented using any form of computer-readable media that is accessible by the user device **102**.

Furthermore, this disclosure provides various example implementations, as described and as illustrated in the drawings. However, this disclosure is not limited to the implementations described and illustrated herein, but can extend to other implementations, as would be known or as would become known to those skilled in the art. Reference in the specification to "one implementation," "this implementation," "these implementations" or "some implementations" means that a particular feature, structure, or characteristic described is included in at least one implementation, and the appearances of these phrases in various places in the specification are not necessarily all referring to the same implementation.

CONCLUSION

Although the subject matter has been described in language specific to structural features and/or methodological acts, the subject matter defined in the appended claims is not limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims. This disclosure is intended to cover any and all adaptations or variations of the disclosed implementations, and the following claims should not be construed to be limited to the specific implementations disclosed in the specification. Instead, the scope of this document is to be determined entirely by the following claims, along with the full range of equivalents to which such claims are entitled.

The invention claimed is:

1. A method comprising:

receiving a selection of a first portion of video content, wherein:

the video content includes a frame comprising one or more words in a first language, the one or more words being composed of a set of characters; and

the selection indicates a subset of characters in the set of characters, a first character of the subset of characters representing a first boundary of the selection and a second character of the subset of characters representing a second boundary of the selection;

using gradient-based text detection to determine a second portion of the video content based on the selection, wherein the second portion comprises the set of characters and extends beyond at least one of the first boundary or the second boundary, and wherein determining the second portion of the video content comprises moving a horizontal line segment associated with the first portion at least one of vertically upwards or vertically downwards along the subset of characters until a non-edge horizontal line segment is encountered;

creating an image comprising the second portion; and

causing a translation of the second portion to be provided, wherein the translation is based on the image and includes the one or more words in a second language.

2. The method of claim **1**, wherein receiving the selection of the first portion causes a bounding shape to be provided around the first portion.

3. The method of claim **1**, wherein causing the translation of the second portion to be provided comprises causing display of the translation.

4. The method of claim **1**, wherein causing the translation of the second portion to be provided comprises causing audio output of the one or more words in the second language.

5. The method of claim **1**, wherein receiving the selection of the first portion comprises:

receiving the selection of the first portion in a first section of a user interface; and

causing the first portion to be displayed in a second section of the user interface, the first section being different from the second section.

6. The method of claim **1**, the method further comprising:

after receiving the selection of the first portion, performing at least one of:

local and global thresholding; or

connected component analysis.

7. The method of claim **1**, receiving the selection of the first portion comprising receiving, at a touchscreen:

a tap on the touchscreen; or

an approximately circular gesture on the touchscreen.

8. A system comprising:

a processor; and

memory comprising computer executable instructions that, when executed, perform operations comprising:

receiving a selection of a first portion of the video content, wherein the video content comprises one or more words composed of a set of characters in a first language, and wherein the selection encloses a subset of characters in the set of characters, a first character of the subset of characters representing a first boundary of the selection and a second character of the subset of characters representing a second boundary of the selection;

using gradient-based text detection to determine a second portion of the video content based on the selection, wherein the second portion comprises the set of characters and extends beyond at least one of the first boundary or the second boundary, and wherein determining the second portion of the video content comprises moving a vertical line segment associated with the first portion at least one of horizontally leftward from the first boundary of the first portion or horizontally rightward from the second boundary of the first portion until a non-edge vertical line segment is encountered;

creating an image comprising the second portion; and

causing a translation of the second portion to be provided, wherein the translation is based on the image and includes the one or more words in a second language.

9. The system of claim **8**, wherein the selection is a circular gesture or a swipe gesture.

10. The system of claim **8**, wherein receiving the selection comprises positioning, by a user, an overlay over the subset of characters of the first language.

11. The system of claim **10**, wherein the overlay is a cross mark or a bounding box.

12. The system of claim **8**, wherein, in response to receiving the selection, the subset of characters are magnified.

13. The system of claim **8**, wherein, in response to receiving the selection, the subset of characters are provided for presentation in a callout window of the user interface that is playing or recording the video content.

14. The system of claim **8**, the operations further comprising:

in response to receiving the selection, identifying a frame in the selection; and

converting content in the frame from red-green-blue (RGB) to grayscale.

15. The system of claim **8**, wherein at least one word of the one or more words is displayed at a non-horizontal angle relative to an edge of a display device presenting the video content.

16. The system of claim **8**, wherein determining the second portion of the video content comprises identifying a ratio of a minimum gap between the set of characters to height of the set of characters.

17. A device comprising:

a processor; and

memory comprising computer executable instructions that, when executed, perform operations comprising:

receiving, in a first section of a user interface, selection of a first portion of a video content, wherein the video content comprises one or more words composed of a set of characters in a first language, and wherein the selection encloses a subset of characters in the set of characters, a first character of the subset of characters representing a first boundary of the selection and a second character of the subset of characters representing a second boundary of the selection;

providing, in a second section of the user interface, the first portion for presentation, wherein the first portion presented in the second section is enlarged compare to the first portion in the first section;

determining a second portion of the video content based on the selection, wherein the second portion comprises the set of characters and extends beyond at least one of the first boundary or the second boundary, and wherein determining the second portion of the video content comprises moving a horizontal line segment associated with the first portion at least one of vertically upwards or vertically downwards along the subset of characters until a non-edge horizontal line segment is encountered;

creating an image comprising the second portion; and

causing a translation of the second portion to be provided, wherein the translation is based on the image and includes the one or more words in a second language.

18. The device of claim **17**, wherein receiving the selection of the first portion causes a bounding box to be provided around the first portion.

19. The device of claim **17**, wherein causing the translation of the second portion to be provided comprises causing audio output of the one or more words in the second language.

20. The device of claim **17**, wherein receiving the selection of the first portion comprising receiving at least one of a tap gesture or a swipe gesture on the user interface.

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