NEAR FIELD COMMUNICATION-BASED SERVICE PROCESSING METHOD, APPARATUS, AND DEVICE

[0001] This application claims priority to Chinese Patent Application No. 202510326036.7, filed with the China National Intellectual Property Administration on March 18, 2025 and entitled "NEAR FIELD COMMUNICATION-BASED SERVICE PROCESSING METHOD, APPARATUS, AND DEVICE", which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] This specification relates to the field of near field communication technologies, and in particular, to a near field communication-based service processing method, apparatus, and device.

BACKGROUND

[0003] With rapid development of electronic payment technologies, near field communication (NFC)-based payment is gradually widely applied because of convenience.

[0004] The near field communication-based payment allows a user to complete a transaction by simply moving a mobile terminal (for example, a smartphone or a smartwatch) that supports near field communication to approach a checkout device of a merchant that supports near field communication. In this process, accurate and rapid detection of approach between the devices of the two parties is essential for smooth start and security of a payment procedure.

[0005] Currently, in a near field communication payment scenario, a solution for detecting approach between devices is mainly based on a conventional electromagnetic induction or radio frequency signal detection technology. However, these technologies may face challenges in some complex environments. For example, in an environment in which there is electromagnetic interference, incorrect determining or detection sensitivity may occur, reducing reliability of near field communication service processing.

[0006] Based on this, a more reliable near field communication service processing solution is needed.

SUMMARY

[0007] One or more embodiments of this specification provide a near field communication-based service processing method, apparatus, device, and a storage medium, to resolve the following technical problem: A more reliable near field communication service processing solution is needed.

[0008] To resolve the above-mentioned technical problem, one or more embodiments of this specification are implemented as follows:

[0009] One or more embodiments of this specification provide a near field communication-based service processing method, applied to a near field communication device of a service provider. The method includes:

capturing, through a bone conduction microphone deployed on the near field communication device in response to an action of moving, by a user, a mobile terminal to approach and touch the near field communication device, a sound generated due to the touch;

detecting the sound to determine an event that matches the sound; and

correspondingly executing a near field communication-based service for the mobile terminal based on the event.

[0010] One or more embodiments of this specification provide a near field communication-based service processing apparatus, applied to a near field communication device of a service provider. The apparatus includes:

a touch sound capture module, configured to capture, through a bone conduction microphone deployed on the near field communication device in response to an action of moving, by a user, a mobile terminal to approach and touch the near field communication device, a sound generated due to the touch;

a touch sound detection module, configured to detect the sound to determine an event that matches the sound; and

a near field communication service execution module, configured to correspondingly execute a near field communication-based service for the mobile terminal based on the event.

[0011] One or more embodiments of this specification provide a near field communication-based service processing device, applied to a near field communication device of a service provider. The service processing device includes a bone conduction microphone-based sound capture

module, an event detection module, and a near field communication control module.

[0012] The bone conduction microphone-based sound capture module is configured to capture, through a bone conduction microphone deployed on the near field communication device in response to an action of moving, by a user, a mobile terminal to approach and touch the near field communication device, a sound generated due to the touch.

[0013] The event detection module is configured to detect the sound to determine an event that matches the sound.

[0014] The near field communication control module is configured to correspondingly execute a near field communication-based service for the mobile terminal based on the event.

[0015] One or more embodiments of this specification provide a near field communication-based service processing device, applied to a near field communication device of a service provider. The service processing device includes:

at least one processor; and

a storage communicatively connected to the at least one processor.

[0016] The storage stores instructions executable by the at least one processor, and the instructions are executed by the at least one processor to enable the at least one processor to perform the following operations:

capturing, through a bone conduction microphone deployed on the near field communication device in response to an action of moving, by a user, a mobile terminal to approach and touch the near field communication device, a sound generated due to the touch;

detecting the sound to determine an event that matches the sound; and

correspondingly executing a near field communication-based service for the mobile terminal based on the event.

[0017] One or more embodiments of this specification provide a non-volatile computer storage medium, applied to a near field communication device of a service provider. The medium stores computer-executable instructions, and the computer-executable instructions are set to perform the following operations:

capturing, through a bone conduction microphone deployed on the near field communication device in response to an action of moving, by a user, a mobile terminal to approach and touch the near field communication device, a sound generated due to the touch;

detecting the sound to determine an event that matches the sound; and

correspondingly executing a near field communication-based service for the mobile terminal based on the event.

[0018] The above-mentioned at least one technical solution used in the one or more embodiments of this specification can achieve the following beneficial effects: A bone conduction microphone is deployed on a near field communication device (for example, a checkout device of a merchant) of a service provider. When a user moves a mobile terminal to approach the near field communication device, because of factors such as inertia and a desire for reliability, the mobile terminal usually not only approaches the near field communication device, but also touches the near field communication device. Based on this, the bone conduction microphone is deployed to actively capture a sound generated due to such a touch, and the sound is further detected to attempt to performing matching with a corresponding event, so that it can be identified whether there is actually a user requesting a near field communication service, and then service execution is correspondingly triggered. A detection and identification principle in this manner is based on a sound that is a mechanical wave, rather than an electromagnetic wave. Therefore, even in an environment in which there is electromagnetic interference, detection and identification can still be reliably performed, thereby helping more reliably execute the near field communication service.

BRIEF DESCRIPTION OF DRAWINGS

[0019] To describe the technical solutions in the embodiments of this specification or in the conventional technology more clearly, the following briefly describes the accompanying drawings needed for describing the embodiments or the conventional technology. Clearly, the accompanying drawings in the following descriptions merely show some embodiments of this specification, and a person of ordinary skill in the art can still derive other drawings from these accompanying drawings without creative efforts.

[0020] FIG. 1 is a schematic flowchart of a near field communication-based service processing method according to one or more embodiments of this specification;

[0021] FIG. 2 is a top-view schematic diagram of a checkout device that supports near field communication according to one or more embodiments of this specification;

[0022] FIG. 3 is a cross-sectional schematic diagram of a checkout device that supports near field communication according to one or more embodiments of this specification;

[0023] FIG. 4 is a schematic diagram of working cooperation between modules in a near field communication-based service processing device according to one or more embodiments of this specification;

[0024] FIG. 5 is a schematic diagram of working cooperation between submodules in a bone conduction microphone-based sound capture module according to one or more embodiments of this specification;

[0025] FIG. 6 is a schematic diagram of a working procedure of an event detection module according to one or more embodiments of this specification;

[0026] FIG. 7 is a schematic diagram of a time domain feature of a valid touch event according to one or more embodiments of this specification;

[0027] FIG. 8 is a schematic diagram of a frequency domain energy distribution feature of a valid touch event according to one or more embodiments of this specification;

[0028] FIG. 9 is a spectrogram of a valid touch event according to one or more embodiments of this specification;

[0029] FIG. 10 is a schematic flowchart of a near field communication service processing solution based on additional audio assistance according to one or more embodiments of this specification;

[0030] FIG. 11 is a schematic structural diagram of a near field communication-based service processing apparatus according to one or more embodiments of this specification; and

[0031] FIG. 12 is a schematic structural diagram of a near field communication-based service processing device according to one or more embodiments of this specification.

DESCRIPTION OF EMBODIMENTS

[0032] Embodiments of this specification provide a near field communication-based service processing method, apparatus, device, and a storage medium.

[0033] To make a person skilled in the art better understand the technical solutions in this specification, the following clearly and comprehensively describes the technical solutions in the embodiments of this specification with reference to the accompanying drawings in the embodiments of this specification. Clearly, the described embodiments are merely some but not all of the embodiments of this application. All other embodiments obtained by a person of ordinary

skill in the art based on the embodiments of this specification without creative efforts shall fall within the protection scope of this application.

[0034] For near field communication-based payment, to facilitate more reliable and accurate operation of a user, the user can be directed to trigger near field communication between devices in a "touch" manner. "Touch" means that the user moves a mobile terminal (usually a smartphone, where for ease of description, the smartphone is used as an example for description in some of the following embodiments) to approach a checkout device of a merchant and then touch a specified near field communication sensing region on the checkout device. Therefore, the near field communication-based payment can also be vividly referred to as "touch" payment.

[0035] To resolve the problem in the background, this application provides a more reliable solution for detecting a "touch" action of a smartphone on a checkout device, and a near field communication-based payment service is more reliably implemented based on this. Certainly, similarly, another near field communication-based service scenario can be used, for example, check-in, gaming, or another service scenario in which physical contact between devices may be involved.

[0036] In the near field communication-based payment service research and development project in which the applicant participates, it is aware that accurate detection of the "touch" action of the smartphone by the near field communication checkout device greatly helps improve a payment success rate. This is mainly reflected in the following five aspects (some improvement and optimization ideas in the field of near field communication are also involved):

[0037] According to a first aspect, in a payment mode of an NFC payment scenario, the checkout device supports an NFC card reader mode, and the smartphone can be emulated into a contactless bank card by using a solution such as host card emulation (HCE). The checkout device in the NFC card reader mode can continuously transmit a radio frequency field when detecting an object approaching. The smartphone approaching the checkout device can send an NFC response packet to the checkout device under excitation of the radio frequency field. The NFC response packet carries encrypted payment information such as a virtual token of a bank card. The checkout device performs verification and then completes a transaction. In this process, a capability of the NFC checkout device to accurately detect approach of the smartphone is crucial, directly determines a connection success rate and a payment delay, and is one of key factors for improving user experience.

[0038] According to a second aspect, in another payment mode of an NFC payment scenario, the smartphone is designed as an NFC card reader. Further, the smartphone is a mobile device, and a mobile phone device manufacturer gives priority to a low power consumption objective, and implements a series of low-power restrictions and optimizations for near field communication card reader mode. Usually, a low power card detection (LPCD) mode or a hybrid mode (mixing normal card polling and a LPCD mode) is used. A radio frequency field is turned off when there is no near field communication tag, to reduce power consumption of the mobile phone. When the mobile phone approaches a near field communication tag, the near field communication tag can be detected. Due to presence of the low power card detection mode, in a process of reading the near field communication tag by the mobile phone serving as a near field communication card reader, a sensing distance is significantly shortened, and sensitivity is reduced, resulting in a severe decrease in accuracy of reading the near field communication tag by the mobile phone and a significant increase in a delay of reading the near field communication tag. In this case, after detecting the "touch" action of the mobile phone, the near field communication checkout device can trigger a series of signal enhancement mechanisms to help the mobile phone exit the low power mode, thereby improving a card swiping success rate.

[0039] According to a third aspect, in a near field communication-based payment scenario, it is found that payment cannot be smoothly performed because some users do not turn on near field communication function switches on mobile phones. This brings inconvenience to the users in actual use. To improve user experience and optimize a payment procedure, the following function can be implemented by using a technical means: When detecting the payment triggering action of "touch", the checkout device can pop up guidance information in a screen interface of the device at a proper time, to clearly notify the user that the near field communication function switch is not currently turned on, and provide a detailed operation step guide for the user, so as to help the user quickly turn on the near field communication function switch and complete other related configurations, thereby smoothly performing payment. Such a design can effectively reduce occurrence of a payment failure caused by negligence of the user in not turning on the near field communication switch, and improve a payment success rate and user satisfaction.

[0040] According to a fourth aspect, to facilitate comprehensive data statistics collection and in-depth analysis, a robust system mechanism needs to be constructed to focus on a near field communication-based payment link, particularly a capability to accurately detect a payment failure.

When the "touch" action is detected but payment cannot be normally performed, the system should record a corresponding payment failure log accurately and in detail. On this basis, to ensure continuity and convenience of user payment experience, the system needs to provide timely guidance for a user. After the payment failure is detected, the user should be notified of a payment problem in a payment interface or in other proper notification manners, and other available payment methods should be clearly recommended to the user, for example, the user is directed to use conventional and reliable payment methods such as two-dimensional code payment and bank card payment. In addition, a corresponding operation guide should be provided to help the user successfully complete payment and avoid transaction interruption and user dissatisfaction caused by the payment failure.

[0041] According to a fifth aspect, after detecting the "touch" action of a mobile phone of a user, the checkout device that supports near field communication can start a series of rich and diverse interactive operations. The device can respond by making a specific alert tone, turning on an indicator, or displaying a dynamic interaction pattern on a screen, or in another manner. For example, a crisp "Ding" sound accompanied by a flashing color animation on the screen allows the user to intuitively feel that the device has received a "touch" interaction signal. This timely feedback can enhance smoothness and fun of user experience. The device can further use this opportunity to deliver some advertisements and benefits to the user. For advertisement delivery, information about a product or a service related to a merchant can be displayed, for example, a promotional activity being conducted in a nearby store or introductions to newly launched popular products. The advertisement content can be played in a visually appealing, scrolling manner on the device screen to attract attention of the user.

[0042] It can be learned that all of the above-mentioned aspects require accurate detection of a valid "touch" action.

[0043] However, in the conventional technology, for a near field communication scenario, only device approach detection is performed. In addition, there are some problems. Current device approach detection is mainly performed in the following manners:

[0044] In a first manner, magnetic field induction is used. An antenna coil is built into a near field communication device. When two near field communication devices approach, an antenna coil in one device generates a variable magnetic field. According to the electromagnetic induction law, an antenna coil in the other device generates an induced current under action of this variable

magnetic field, to detect approach of the peer device. This magnetic field induction is a basis for near field communication, and is a key mechanism for detecting device approach. In a payment scenario, when a user moves a smartphone to approach a checkout device, antenna coils of the smartphone and the checkout device interact with each other to generate an induced current. The checkout device senses approach of the smartphone based on this, and prepares to perform a subsequent data transmission and payment operation.

[0045] In a second manner, radio frequency signal strength detection is performed. During working, a near field communication device continuously transmits and receives a radio frequency signal of a specific frequency. When two devices approach, signal strength is gradually enhanced. The device monitors a change in the signal strength in real time through a built-in signal detection circuit. When the signal strength reaches a specific threshold, it can be determined that the other near field communication device approaches.

[0046] In a third manner, protocol interaction is performed. A specific communication protocol is followed between near field communication devices for data exchange. After two devices approach and enter communication ranges of each other, protocol handshake and interaction are started. In this process, the device can confirm presence and approach of the other party through information exchange at a protocol layer. In a payment scenario, after approaching, a smartphone and a checkout device perform a series of information exchange based on a near field communication protocol, for example, device identification and payment information transmission. If protocol interaction can be successfully completed between the devices, it can be determined that the devices approach and a payment operation can be performed.

[0047] The above-mentioned device approach detection manners separately have one or more of the following problems:

[0048] Environmental interference: In a practical scenario, a checkout device is usually in a complex electromagnetic environment, for example, a shopping mall, a metro station, or another crowded place with many electronic devices. A conventional manner of detecting an approach event based on a radio frequency signal is susceptible to interference from another surrounding wireless signal source. The interference may lead to incorrect determining of approach of a smartphone of a user by the checkout device, and non-payment-related approach is identified as a payment operation, or on the contrary, actual approach of a mobile phone that is intended to perform payment cannot be accurately detected, affecting payment efficiency and user experience.

[0049] Contradiction between sensitivity and accuracy: When the sensitivity is improved to ensure that potential payment operations are not missed, it is usually difficult to consider the accuracy. For example, an excessively sensitive setting may frequently trigger an unnecessary detection procedure due to a slight electromagnetic fluctuation in a surrounding environment. This increases a system burden, and may cause a payment error. However, if the sensitivity is reduced to improve the accuracy, a problem that no timely response can be made when a device that actually has an intention approaches may occur.

[0050] Device compatibility: With the popularization of near field communication technologies, there are a plurality of types and versions of checkout devices and mobile terminals that support near field communication in the market. There may be differences in radio frequency characteristics or protocols between different devices. This makes the above-mentioned manners face difficulties in terms of cross-device compatibility, and may lead to inaccurate or unstable approach detection between some device combinations.

[0051] To resolve the above-mentioned problems and meet the above-mentioned requirements, the solutions in this application are provided. Based on such an overall situation, the following continues to describe the solutions in this application.

[0052] FIG. 1 is a schematic flowchart of a near field communication-based service processing method according to one or more embodiments of this specification. The method is applied to a near field communication device of a service provider. The service provider is relative to a served user. Typically, the service provider is a merchant, and the near field communication device is correspondingly, for example, a checkout device or a vending device. In a non-transaction scenario, the service provider can be a manager (for example, a property manager or a company attendance manager), and the near field communication device is correspondingly, for example, an access control device or a check-in device.

[0053] The procedure in FIG. 1 includes the following steps.

[0054] S102: Capture, through a bone conduction microphone deployed on the near field communication device in response to an action of moving, by a user, a mobile terminal to approach and touch the near field communication device, a sound generated due to the touch.

[0055] The mobile terminal (for example, a smartphone or a smartwatch) of the user also needs to support near field communication, and is actually also a near field communication device, but for ease of description, is mainly referred to as a mobile terminal. The near field communication

device in this embodiment is mainly the near field communication device of the service provider, or may collectively refer to devices of both the user and the service provider. It is easy to correctly understand and distinguish which case it is based on context descriptions.

[0056] To facilitate a user operation, a near field communication sensing region is specified on the near field communication device. If the user wants to implement a near field communication service, the mobile terminal that supports near field communication can approach and touch the near field communication sensing region. In this case, at least a sound made by the touch can be generated.

[0057] It should be noted that the sound generated due to the touch can further include more sounds, for example, an additional sound generated by actively controlling the mobile terminal to cooperate with the touch action. This is described below by using an example.

[0058] The bone conduction microphone uses a bone conduction technology, can receive a sound or another mechanical vibration signal by sensing vibration of a solid medium (for example, a bone), and is usually used in the headset field. In this application, the bone conduction microphone is innovatively applied to the near field communication field, and is particularly applied to the near field communication-based payment field. A housing of the near field communication device is used as a sensing solid medium instead of a bone, to resolve a problem that a near field communication service may not be reliably triggered currently.

[0059] In one or more embodiments of this specification, in response to an action of moving, by the user, the mobile terminal to approach and touch the specified near field communication sensing region on the near field communication device, a sound generated due to the touch is captured through the bone conduction microphone deployed inside the housing of the near field communication device. The bone conduction microphone is located below the near field communication sensing region. In particular, the bone conduction microphone can be in close contact with an inner side of the housing, so that the housing becomes a sound conduction medium. The mobile terminal touches the housing, and a distance between the bone conduction microphone and the mobile terminal is shorter. Therefore, a sound conduction effect is better.

[0060] In one or more embodiments of this specification, a surrounding environmental electromagnetic signal can be detected in advance. It is determined, based on the environmental electromagnetic signal, whether environmental electromagnetic interference exceeds a predetermined degree. If yes, the bone conduction microphone deployed on the near field

communication device is started, so that the bone conduction microphone is in an on state (to enter a sound capture state). Otherwise, it indicates that an environment is relatively friendly. In this case, the bone conduction microphone can be enabled to be in an off state, and approach detection is performed based on another existing means, to avoid a waste of processing resources.

[0061] S104: Detect the sound to determine an event that matches the sound.

[0062] In one or more embodiments of this specification, one or more events are predefined, including at least a touch event that occurs because the user currently actually wants to perform near field interaction (that is, the user has a corresponding intention) and uses the mobile terminal to touch the near field communication device. For ease of description, such a touch event is referred to as a valid touch event (which can also be referred to as an active touch event in which the user has a service intention). In addition, there can be further a stricter requirement for the word "valid" based on a requirement. For example, not only the user needs to have a corresponding intention, but also the user needs to actually perform a touch action. For example, if a touch region is not the near field communication sensing region, this may not be a valid touch event. This is because in this case, a sound conduction distance changes, affecting a sound detection result.

[0063] In addition to the valid touch event, another event can be defined based on a requirement, for example, an invalid touch event opposite to the valid touch event. In addition, for the defined event, a finer granularity can be further used. For example, based on different touch modes, a plurality of different valid touch events are correspondingly defined to implement more service uses, for example, to trigger different near field communication services, so that service diversity and flexibility of the near field communication device at a merchant can be improved, and more service functions can be provided to the user. This helps broaden use scenarios of the near field communication device and improve enthusiasm of the user for preferentially using the near field communication device at the merchant.

[0064] An acoustic feature exhibited by the sound is detected to infer whether the sound matches a defined event. For example, if it is inferred that the sound matches the valid touch event, it can be considered that there is currently a user actively performing the "touch" action on the near field communication device, to request to execute a near field communication service. On the contrary, if it is inferred that the sound matches the invalid touch event, it can be considered that there may be environmental noise or the near field communication device is accidentally touched, and therefore this can be ignored.

[0065] S106: Correspondingly execute a near field communication-based service for the mobile terminal based on the event.

[0066] For the valid touch event, further interaction with the mobile terminal can be performed to execute the near field communication-based service. For example, a near field communication-based payment procedure is performed, and payment-related information is exchanged, to perform deduction for the user, so that the user can normally complete this payment in a near field communication manner.

[0067] It should be noted that "executing the near field communication-based service" can further include an auxiliary action that helps improve reliability or efficiency. For example, a near field communication signal of the near field communication device and/or a near field communication signal of the mobile terminal are and/or is controlled, in response to the valid touch event, to be enhanced, and a service is executed based on an enhanced near field communication signal. For example, the mobile terminal is controlled. For example, for the valid touch event, the near field communication device actively sends an excitation signal to the mobile terminal, to trigger (indirectly control) the mobile terminal to exit a low power mode, so as to more efficiently and reliably perform near field communication interaction with the near field communication device.

[0068] To better support the scenario of this application, the bone conduction microphone can be designed to be sensitive to a vibration at a specific frequency and intensity. By optimizing a capability of the bone conduction microphone to detect a small vibration generated when the near field communication device is touched, high-precision approach and touch detection can be implemented. This vibration characteristic-based detection manner can effectively distinguish between an intentional touch of a device and another unrelated environmental vibration, thereby improving detection accuracy.

[0069] According to the method in FIG. 1, a bone conduction microphone is deployed on a near field communication device (for example, a checkout device of a merchant) of a service provider. When a user moves a mobile terminal to approach the near field communication device, because of factors such as inertia and a desire for reliability, the mobile terminal usually not only approaches the near field communication device, but also touches the near field communication device. Based on this, the bone conduction microphone is deployed to actively capture a sound generated due to such a touch, and the sound is further detected to attempt to performing matching

with a corresponding event, so that it can be identified whether there is actually a user requesting a near field communication service, and then service execution is correspondingly triggered. A detection and identification principle in this manner is based on a sound that is a mechanical wave, rather than an electromagnetic wave. Therefore, even in an environment in which there is electromagnetic interference, detection and identification can still be reliably performed, thereby helping more reliably execute the near field communication service.

[0070] Based on the method in FIG. 1, this specification further provides some specific implementation solutions and extension solutions of the method. The following continues to provide descriptions.

[0071] In one or more embodiments of this specification, the bone conduction microphone is located in a soundproof sealed cavity disposed below the near field communication sensing region. The soundproof sealed cavity is formed through enclosing by a part of the housing of the near field communication device and a shock-absorbing sealing material surface deployed inside the housing of the near field communication device, and the bone conduction microphone is in contact with an inner surface of the part of the housing. This helps more accurately capture a "touch" sound. For ease of understanding, more intuitively, descriptions are provided with reference to an example checkout device that supports near field communication. References can be made to FIG. 2 and FIG. 3.

[0072] FIG. 2 is a top-view schematic diagram of a checkout device that supports near field communication according to one or more embodiments of this specification. It can be learned that a circular region on a right side of the checkout device in FIG. 2 is a near field communication sensing region, and a strip-shaped region on a left side can be a display region. To facilitate a user operation, a microphone icon is further displayed in the near field communication sensing region, to indicate that there is a microphone that can receive a sound herein, which is specifically a bone conduction microphone. This is relatively intuitive for a user.

[0073] FIG. 3 is a cross-sectional schematic diagram of a checkout device that supports near field communication according to one or more embodiments of this specification. It can be learned that in FIG. 3, a near field communication sensing region is raised upward. A cover plate (for example, made of a material such as glass or plastic) is a part of a housing of a near field communication device, and a bone conduction microphone is in close contact with a lower surface of the cover plate to avoid poor contact such as a gap. A shock-absorbing sealing material is used

between the cover plate and a lower component to form an isolation surface, so as to ensure airtightness of a cavity in which the bone conduction microphone is located and avoid propagation of other mechanical vibrations and air vibrations to the bone conduction microphone.

[0074] In one or more embodiments of this specification, time domain analysis and/or frequency domain analysis can be specifically performed when the sound captured by the bone conduction microphone deployed on the near field communication device is detected. To improve efficiency and accuracy, preprocessing is performed in a sound capture phase to obtain a more targeted sound. References can be made to FIG. 4 and FIG. 5.

[0075] FIG. 4 is a schematic diagram of working cooperation between modules in a near field communication-based service processing device according to one or more embodiments of this specification.

[0076] The service processing device in FIG. 4 can be a near field communication device, and in a payment scenario, can be specifically a checkout device. The schematic appearance diagram in FIG. 2 is used herein. The service processing device includes a bone conduction microphone-based sound capture module, an event detection module, and a near field communication control module. The bone conduction microphone-based sound capture module is configured to capture, through a bone conduction microphone deployed on the near field communication device in response to an action of moving, by a user, a mobile terminal to approach and touch the near field communication device, a sound generated due to the touch. The event detection module is configured to detect the sound to determine an event that matches the sound. The near field communication control module is configured to correspondingly execute a near field communication-based service for the mobile terminal based on the event.

[0077] Optionally, the service processing device can further include a housing and a soundproof sealed cavity. The bone conduction microphone is located in the soundproof sealed cavity disposed below a near field communication sensing region. The soundproof sealed cavity is formed through enclosing by a part of the housing and a shock-absorbing sealing material surface deployed inside the housing, and the bone conduction microphone is in contact with an inner surface of the part of the housing.

[0078] FIG. 5 is a schematic diagram of working cooperation between submodules in a bone conduction microphone-based sound capture module according to one or more embodiments of this specification.

[0079] In consideration of a software part, the sound capture module includes a sensitivity setting submodule, an ADC submodule, and a band-pass filter submodule. The sensitivity setting submodule is configured to reduce sensitivity of a bone conduction microphone, to pick up only a larger sound than a touch. The ADC submodule is configured to convert a sound analog signal into a digital signal. A required sampling frequency is, for example, 16 kHz, and can be as low as 8 kHz. The band-pass filter submodule, for example, filters out sound signals less than 100 Hz and greater than 2000 Hz, and retains only some 100 Hz–2000 Hz sounds (which relatively match a corresponding feature of "touch"), to subsequently perform targeted detection.

[0080] In one or more embodiments of this specification, the detecting the sound to determine an event that matches the sound can specifically include: performing time domain analysis on the sound, and collecting statistics on short-time window energy by using a short-time window of a specified length, to obtain a plurality of corresponding short-time window energy frames; collecting statistics on an inter-frame energy rise rate and/or an inter-frame energy fall rate of the plurality of short-time window energy frames; and if the inter-frame energy rise rate is less than a specified rise threshold, and/or if the inter-frame energy fall rate is greater than a specified fall threshold, determining that the sound matches the invalid touch event. Further, the following can be further included: if it is determined, based on the inter-frame energy rise rate and the inter-frame energy fall rate, that the sound does not match the invalid touch event, performing frequency domain analysis on the sound; converting a time domain signal of the sound into a frequency domain signal, and performing division to obtain a plurality of frequency bands; collecting statistics on energy of the frequency domain signal on each of the frequency bands to generate an energy distribution curve; calculating a similarity between the energy distribution curve and a predetermined standard distribution curve corresponding to a valid touch event; and determining, based on the similarity, whether the sound matches the valid touch event.

[0081] Based on such a detection idea, more intuitively, one or more embodiments of this specification further provide a schematic diagram of a working procedure of an event detection module. References can be made to FIG. 6.

[0082] For the valid touch event (mainly an event caused by the "touch" action concerned in this application), based on some actual test data, it is observed that the valid touch event has duration of approximately 40 ms, is a short-time signal, has a relatively large rising edge, is a burst signal, and in time domain, rises relatively rapidly (a slower rise may indicate another interference

signal) and falls relatively slowly (an excessively rapid fall may also indicate another interference signal). Therefore, statistics on short-time average energy can be collected. When a rapid signal change occurs, it is considered that a valid touch event may occur. In frequency domain, based on some actual test data, it is observed that the valid touch event is mainly concentrated on 100 Hz–1000 Hz in frequency domain, and shows a form of high in the middle and low at two ends. The form is converted into a mathematical distribution, and distribution similarity is determined through comparison, to help identify a corresponding touch sound.

[0083] Based on such a principle, in FIG. 6, in a time domain analysis part, for example, statistics on 10 ms short-time window energy are collected. Then, short-time smoothed energy is obtained, and statistics on the inter-frame energy rise rate, the inter-frame energy fall rate, and signal duration are collected. Based on threshold comparison, it is preliminarily determined whether the event is an invalid touch event. If the invalid touch event is not hit, frequency domain analysis is further performed. First, the time domain signal is converted into the frequency domain signal through fast Fourier transform, and then the 100 Hz–2000 Hz signal can be divided into 20 frequency bands, which jointly form a mathematical distribution curve. A similarity between the curve and the standard distribution curve obtained offline is calculated. When the similarity is sufficiently high, the event can be determined as a valid touch event. The standard distribution curve can be obtained in advance by calculating an average value of a plurality of pieces of touch data of a plurality of models and a plurality of material combinations in a laboratory.

[0084] Further, schematic diagrams of some signals involved in the detection process are generated. References can be made to FIG. 7 to FIG. 9.

[0085] FIG. 7 is a schematic diagram of a time domain feature of a valid touch event according to one or more embodiments of this specification. It can be learned that in time domain, a feature indicating a rapid rise and a slow fall is presented.

[0086] FIG. 8 is a schematic diagram of a frequency domain energy distribution feature of a valid touch event according to one or more embodiments of this specification. It can be learned that the valid touch event is mainly concentrated on a frequency band of 100 Hz–1000 Hz in frequency domain. Similarly, if a sound generated by "touch" is considered as voice data for analysis, FIG. 9 is a spectrogram of a valid touch event according to one or more embodiments of this specification, and a similar frequency domain feature is also displayed.

[0087] In one or more embodiments of this specification, considering that a sound made by

the touch is relatively simple, and may be confused with a sound made by another accidental touch, different touch modes are considered to be provided, so that valid sounds that involve a near field communication service execution intention can be more diversified. In addition, auxiliary audio is considered to be provided to help further improve detection reliability and service flexibility. References can be made to FIG. 10.

[0088] FIG. 10 is a schematic flowchart of a near field communication service processing solution based on additional audio assistance according to one or more embodiments of this specification. In the scenario in FIG. 10, the touch action in FIG. 1 is performed by the user by using one of a plurality of different prompted touch modes, and the matched event is a touch event corresponding to the one touch mode. The plurality of different touch modes (which reflect how the user performs an operation) respectively correspond to different corresponding touch events (which reflect events directly generated by the operations, where for example, a single light touch operation corresponds to a single light touch event).

[0089] The procedure in FIG. 10 includes the following steps.

[0090] S1002: The mobile terminal determines, in response to the user approaching and touching the near field communication device by using one of a plurality of different prompted touch modes, whether a specified auxiliary sound generation switch is in an on state, and automatically plays audio corresponding to the touch if the touch is detected in the on state.

[0091] In different touch modes, the user performs a touch by using different actions. Differences in such actions are reflected, for example, in different quantities of consecutive touches (for example, one touch or several consecutive touches), different touch force, different touch duration, different contact areas of touches (for example, a touch with a corner of the mobile phone or a touch with a side edge of the mobile phone), different touch-associated contact actions (for example, a point touch, swiping, or drawing a circle), etc.

[0092] To facilitate understanding and a correct operation by the user, the user can be prompted in advance in a manner such as text or voice broadcast. Certainly, a quantity of prompted touch modes can be small, for example, two or three. In this way, the user can easily master the touch mode, and misoperation is not likely to occur.

[0093] During touching, the mobile terminal additionally automatically plays audio, so that the bone conduction microphone on the near field communication device can also receive the audio, to obtain more detection bases. The audio can match a touch mode or a service to be executed by

the user. Such a matching relationship can be preset, especially when audio that includes no voice is selected.

[0094] To enable the user to have a more accurate understanding and improve reliability, the audio can be directly enabled to have a semantic meaning. For example, the audio can be enabled to prompt a corresponding near field communication-based service by using voice, so that the user can implement reconfirmation with reference to the audio. More flexibly, the user can immediately orally send voice to the mobile terminal for indication. In this case, the mobile terminal generates corresponding audio based on the voice (for example, through direct recording, processing based on recorded content, or matching with more standard preset audio), which is automatically played during touching, to accurately convey an intention of the user. This manner can be vividly described as first "saying" to the mobile terminal and then moving the mobile terminal to "touch" the near field communication device. In a relatively noisy environment, there is an advantage because the user can orally send voice to the mobile terminal at almost a zero distance (for example, holding the phone to the mouth), and the near field communication device can capture, based on bone conduction, audio that corresponds to the voice and that is automatically played when the mobile terminal performs a touch. It can be learned that sound transmission processes in both the two phases are less affected by an environment, and therefore applicability is better.

[0095] S1004: The near field communication device captures, through the bone conduction microphone deployed on the near field communication device, a sound made by the touch, and captures a sound of the audio additionally played by the mobile terminal.

[0096] S1006: The near field communication device determines, by detecting the sound captured by the bone conduction microphone, that the sound matches a touch event corresponding to the one touch mode.

[0097] If the audio has semantics, in addition to performing time domain or frequency domain signal analysis, semantic recognition can be performed.

[0098] S1008: The near field communication device determines and executes a near field communication-based service corresponding to the corresponding touch event in a plurality of different near field communication-based services (for example, an instant full payment service, an installment payment service, and a credit service, where certainly, services other than payment can be further introduced), where the plurality of different near field communication-based services respectively correspond to different touch events.

[0099] In this way, for the user, operations are simple, service flexibility is high, and a plurality of different near field communication services can be more reliably supported.

[0100] Based on a same idea, one or more embodiments of this specification further provide an apparatus and a device corresponding to the above-mentioned method, as shown in FIG. 11 and FIG. 12. The apparatus and the device can correspondingly perform the above-mentioned method and related optional solutions.

[0101] FIG. 11 is a schematic structural diagram of a near field communication-based service processing apparatus according to one or more embodiments of this specification, applied to a near field communication device of a service provider. The apparatus includes:

a touch sound capture module 1102, configured to capture, through a bone conduction microphone deployed on the near field communication device in response to an action of moving, by a user, a mobile terminal to approach and touch the near field communication device, a sound generated due to the touch;

a touch sound detection module 1104, configured to detect the sound to determine an event that matches the sound; and

a near field communication service execution module 1106, configured to correspondingly execute a near field communication-based service for the mobile terminal based on the event.

[0102] Optionally, the touch sound capture module 1102 is configured to capture, through the bone conduction microphone deployed inside a housing of the near field communication device in response to an action of moving, by the user, the mobile terminal to approach and touch a specified near field communication sensing region on the near field communication device, a sound generated due to the touch. The bone conduction microphone is located below the near field communication sensing region.

[0103] Optionally, the bone conduction microphone is located in a soundproof sealed cavity disposed below the near field communication sensing region.

[0104] The soundproof sealed cavity is formed through enclosing by a part of the housing of the near field communication device and a shock-absorbing sealing material surface deployed inside the housing of the near field communication device, and the bone conduction microphone is in contact with an inner surface of the part of the housing.

[0105] Optionally, the touch sound detection module 1104 is configured to: perform time

domain analysis on the sound, and collect statistics on short-time window energy by using a short-time window of a specified length, to obtain a plurality of corresponding short-time window energy frames;

collect statistics on an inter-frame energy rise rate and/or an inter-frame energy fall rate of the plurality of short-time window energy frames; and

if the inter-frame energy rise rate is less than a specified rise threshold, and/or if the inter-frame energy fall rate is greater than a specified fall threshold, determine that the sound matches an invalid touch event.

[0106] Optionally, the touch sound detection module 1104 further performs the following operations:

if it is determined, based on the inter-frame energy rise rate and the inter-frame energy fall rate, that the sound does not match the invalid touch event, performing frequency domain analysis on the sound;

converting a time domain signal of the sound into a frequency domain signal, and performing division to obtain a plurality of frequency bands;

collecting statistics on energy of the frequency domain signal on each of the frequency bands to generate an energy distribution curve;

calculating a similarity between the energy distribution curve and a predetermined standard distribution curve corresponding to a valid touch event; and

determining, based on the similarity, whether the sound matches the valid touch event.

[0107] Optionally, before the capturing, through a bone conduction microphone deployed on the near field communication device, a sound generated due to the touch, the apparatus further includes:

detecting a surrounding environmental electromagnetic signal;

determining, based on the environmental electromagnetic signal, whether environmental electromagnetic interference exceeds a predetermined degree; and

if yes, starting the bone conduction microphone deployed on the near field communication device, so that the bone conduction microphone is in a sound capture state.

[0108] Optionally, the touch action is performed by the user by using one of a plurality of different prompted touch modes, the matched event is a touch event corresponding to the one touch mode, and the plurality of different touch modes respectively correspond to different touch events.

[0109] The near field communication service execution module 1106 is configured to determine and execute a near field communication-based service corresponding to the corresponding touch event in a plurality of different near field communication-based services.

[0110] The plurality of different near field communication-based services respectively correspond to different touch events.

[0111] Optionally, the touch sound capture module 1102 is configured to capture a sound made by the touch, and capture a sound of audio that the mobile terminal is triggered to additionally play due to the touch.

[0112] The audio is played by the mobile terminal in the following manner: determining whether a specified auxiliary sound generation switch is in an on state, and automatically playing the audio corresponding to the touch if the touch is detected in the on state.

[0113] Optionally, the audio prompts the near field communication-based service through voice.

[0114] Optionally, the event is a valid touch event.

[0115] The near field communication service execution module 1106 is configured to: control, in response to the valid touch event, a near field communication signal of the near field communication device and/or a near field communication signal of the mobile terminal to be enhanced, and execute a service based on an enhanced near field communication signal.

[0116] Optionally, the service includes a payment service.

[0117] FIG. 12 is a schematic structural diagram of a near field communication-based service processing device according to one or more embodiments of this specification, applied to a near field communication device of a service provider. The service processing device includes:

at least one processor; and

a storage communicatively connected to the at least one processor.

[0118] The storage stores instructions executable by the at least one processor, and the instructions are executed by the at least one processor to enable the at least one processor to perform the following operations:

capturing, through a bone conduction microphone deployed on the near field communication device in response to an action of moving, by a user, a mobile terminal to approach and touch the near field communication device, a sound generated due to the touch;

detecting the sound to determine an event that matches the sound; and

correspondingly executing a near field communication-based service for the mobile terminal based on the event.

[0119] Based on a same idea, one or more embodiments of this specification further provide a non-volatile computer storage medium, applied to a near field communication device of a service provider. The medium stores computer-executable instructions, and the computer-executable instructions are set to perform the following operations:

capturing, through a bone conduction microphone deployed on the near field communication device in response to an action of moving, by a user, a mobile terminal to approach and touch the near field communication device, a sound generated due to the touch;

detecting the sound to determine an event that matches the sound; and

correspondingly executing a near field communication-based service for the mobile terminal based on the event.

[0120] In the 1990s, whether a technical improvement is a hardware improvement (for example, an improvement to a circuit structure, such as a diode, a transistor, or a switch) or a software improvement (an improvement to a method procedure) can be clearly distinguished. However, as technologies develop, current improvements to many method procedures can be considered as direct improvements to hardware circuit structures. Almost all designers obtain the corresponding hardware circuit structure by programming the improved method process into the hardware circuit. Therefore, a method procedure can be improved by using a hardware entity module. For example, a programmable logic device (PLD) (for example, a field programmable gate array (FPGA)) is such an integrated circuit, and a logical function of the PLD is determined by a user through device programming. The designer performs programming to "integrate" a digital system into a PLD without requesting a chip manufacturer to design and produce an application-specific integrated circuit chip. In addition, currently, instead of manually manufacturing an integrated circuit chip, such programming is mostly implemented by using "logic compiler" software. The "logic compiler" software is similar to a software compiler used to develop and write a program. Original code needs to be written in a particular programming language before being compiled. The language is referred to as a hardware description language (HDL). There are many HDLs such as the Advanced Boolean Expression Language (ABEL), the Altera Hardware Description Language (AHDL), Confluence, the Cornell University Programming Language (CUPL), HDCal, the Java Hardware Description Language (JHDL), Lava,

Lola, MyHDL, PALASM, and the Ruby Hardware Description Language (RHDL). Currently, the Very-High-Speed Integrated Circuit Hardware Description Language (VHDL) and Verilog are most commonly used. It should also be clear to a person skilled in the art that a hardware circuit for implementing a logical method procedure can be easily obtained by performing slight logic programming on the method procedure by using the above-mentioned several hardware description languages and programming the method procedure into an integrated circuit.

[0121] A controller can be implemented by using any appropriate method. For example, the controller can be in a form of a microprocessor or a processor, a computer-readable medium that stores computer-readable program code (such as software or firmware) that can be executed by the microprocessor or the processor, a logic gate, a switch, an application-specific integrated circuit (ASIC), a programmable logic controller, or an embedded microcontroller. Examples of the controller include but are not limited to the following microcontrollers: ARC 625D, Atmel AT91SAM, Microchip PIC18F26K20, and Silicone Labs C8051F320. A memory controller can also be implemented as a part of control logic of a memory. A person skilled in the art also knows that in addition to implementing the controller by using only the computer-readable program code, logic programming can be performed on method steps to enable the controller to implement the same function in a form of a logic gate, a switch, an application-specific integrated circuit, a programmable logic controller, an embedded microcontroller, etc. Therefore, the controller can be considered as a hardware component, and an apparatus that is configured to implement various functions and that is included in the controller can also be considered as a structure in the hardware component. Alternatively, the apparatus configured to implement various functions can even be considered as both a software module implementing a method and a structure in the hardware component.

[0122] Systems, apparatuses, modules, or units that are set forth in the previous implementations can be embodied by a computer chip or an entity or by a product with a specific function. A typical implementation device is a computer. Specifically, the computer can be, for example, a personal computer, a laptop computer, a cellular phone, a camera phone, a smartphone, a personal digital assistant, a media player, a navigation device, an email device, a game console, a tablet computer, a wearable device, or a combination of any of these devices.

[0123] For ease of description, the above-mentioned apparatus is divided into units based on functions for separate description. Certainly, when this specification is implemented, the functions

of the units can be implemented in one or more pieces of software and/or hardware.

[0124] A person skilled in the art should understand that embodiments of this specification can be provided as methods, systems, or computer program products. Therefore, the embodiments of this specification can use a form of hardware only embodiments, software only embodiments, or embodiments with a combination of software and hardware. In addition, a form of a computer program product that is implemented on one or more computer-usable storage media (including but not limited to a disk storage, a CD-ROM, an optical storage, etc.) that include computer-usable program code can be used in the embodiments of this specification.

[0125] This specification is described with reference to the flowcharts and/or block diagrams of the method, the device (system), and the computer program product according to embodiments of this specification. It should be understood that each procedure and/or block in the flowcharts and/or the block diagrams and a combination of procedures and/or blocks in the flowcharts and/or the block diagrams can be implemented by using computer program instructions. These computer program instructions can be provided for a general-purpose computer, a special-purpose computer, an embedded processor, or a processor of another programmable data processing device to generate a machine, so that the instructions executed by the computer or the processor of the another programmable data processing device generate an apparatus for implementing a specific function in one or more procedures in the flowcharts and/or in one or more blocks in the block diagrams.

[0126] These computer program instructions can alternatively be stored in a computer-readable memory that can instruct the computer or the another programmable data processing device to work in a specific way, so the instructions stored in the computer-readable memory generate an artifact that includes an instruction apparatus. The instruction apparatus implements a specific function in one or more procedures in the flowcharts and/or in one or more blocks in the block diagrams.

[0127] These computer program instructions can alternatively be loaded onto the computer or the another programmable data processing device, so that a series of operation steps are performed on the computer or the another programmable device, thereby generating computer-implemented processing. Therefore, the instructions executed on the computer or the another programmable device provide steps for implementing a specific function in one or more procedures in the flowcharts and/or in one or more blocks in the block diagrams.

[0128] In a typical configuration, a computing device includes one or more central processing units (CPU), input/output interfaces, network interfaces, and memories.

[0129] The memory may include a non-persistent memory, a random access memory (RAM), a nonvolatile memory, and/or another form in a computer-readable medium, for example, a read-only memory (ROM) or a flash memory (flash RAM). The memory is an example of the computer-readable medium.

[0130] Computer-readable media, including permanent and non-permanent, removable and non-removable media, can be implemented by any method or technology for information storage. The information can be computer-readable instructions, a data structure, a program module, or other data. Examples of the computer storage medium include but are not limited to a phase-change random access memory (PRAM), a static random access memory (SRAM), a dynamic random access memory (DRAM), another type of random access memory (RAM), a read-only memory (ROM), an electrically erasable programmable read-only memory (EEPROM), a flash memory or another memory technology, a compact disc read-only memory (CD-ROM), a digital versatile disc (DVD) or another optical storage, a cassette magnetic tape, a magnetic tape/magnetic disk storage or another magnetic storage device, or any other non-transmission medium. The computer storage medium can be configured to store information accessible to a computing device. As described in this specification, the computer-readable medium does not include computer-readable transitory media such as a modulated data signal and a carrier.

[0131] It is worthwhile to further note that the terms "include", "comprise", or any other variant thereof are intended to cover a non-exclusive inclusion, so that a process, a method, a product, or a device that includes a list of elements not only includes those elements but also includes other elements which are not expressly listed, or further includes elements inherent to such a process, method, product, or device. Without more constraints, an element preceded by "includes a …" does not preclude the presence of additional identical elements in the process, method, product, or device that includes the element.

[0132] This specification can be described in the general context of computer-executable instructions executed by a computer, for example, a program module. Generally, the program module includes a routine, a program, an object, a component, a data structure, etc. executing a specific task or implementing a specific abstract data type. This specification can alternatively be practiced in distributed computing environments. In the distributed computing environments, tasks

are performed by remote processing devices connected through a communication network. In a distributed computing environment, the program module can be located in both local and remote computer storage media including storage devices.

[0133] The embodiments of this specification are described in a progressive method. For same or similar parts in the embodiments, references can be made to each other. Each embodiment focuses on a difference from another embodiment. In particular, the apparatus embodiments, the device embodiments, and the non-volatile computer storage medium embodiments are basically similar to the method embodiments, and therefore are described briefly. For related parts, references can be made to some descriptions of the method embodiments.

[0134] Specific embodiments of this specification are described above. Other embodiments fall within the scope of the appended claims. In some cases, the actions or steps described in the claims can be performed in a sequence different from that in the embodiments, and the desired results can still be achieved. In addition, the process depicted in the accompanying drawings does not necessarily need a particular sequence or consecutive sequence to achieve the desired results. In some implementations, multitasking and parallel processing are feasible or may be advantageous.

[0135] The above-mentioned content is merely one or more embodiments of this specification, and is not intended to limit this specification. A person skilled in the art knows that one or more embodiments of this specification can have various modifications and changes. Any modification, equivalent replacement, improvement, etc. made within the spirit and principle of one or more embodiments of this specification shall fall within the scope of the claims of this specification.

CLAIMS

What is claimed is:

1. A near field communication-based service processing method, applied to a near field communication device of a service provider, wherein the method comprises:

capturing, through a bone conduction microphone deployed on the near field communication device in response to an action of moving, by a user, a mobile terminal to approach and touch the near field communication device, a sound generated due to the touch;

detecting the sound to determine an event that matches the sound; and

correspondingly executing a near field communication-based service for the mobile terminal based on the event.

2. The method according to claim 1, wherein the capturing, through a bone conduction microphone deployed on the near field communication device in response to an action of moving, by a user, a mobile terminal to approach and touch the near field communication device, a sound generated due to the touch specifically comprises:

capturing, through the bone conduction microphone deployed inside a housing of the near field communication device in response to an action of moving, by the user, the mobile terminal to approach and touch a specified near field communication sensing region on the near field communication device, a sound generated due to the touch, wherein the bone conduction microphone is located below the near field communication sensing region.

3. The method according to claim 2, wherein the bone conduction microphone is located in a soundproof sealed cavity disposed below the near field communication sensing region; and

the soundproof sealed cavity is formed through enclosing by a part of the housing of the near field communication device and a shock-absorbing sealing material surface deployed inside the housing of the near field communication device, and the bone conduction microphone is in contact with an inner surface of the part of the housing.

4. The method according to claim 1, wherein the detecting the sound to determine an event that matches the sound specifically comprises:

performing time domain analysis on the sound, and collecting statistics on short-time window energy by using a short-time window of a specified length, to obtain a plurality of corresponding short-time window energy frames;

collecting statistics on an inter-frame energy rise rate and/or an inter-frame energy fall rate of the plurality of short-time window energy frames; and

if the inter-frame energy rise rate is less than a specified rise threshold, and/or if the inter-frame energy fall rate is greater than a specified fall threshold, determining that the sound matches an invalid touch event.

5. The method according to claim 4, wherein the detecting the sound to determine an event that matches the sound further comprises:

if it is determined, based on the inter-frame energy rise rate and the inter-frame energy fall rate, that the sound does not match the invalid touch event, performing frequency domain analysis on the sound;

converting a time domain signal of the sound into a frequency domain signal, and performing division to obtain a plurality of frequency bands;

collecting statistics on energy of the frequency domain signal on each of the frequency bands to generate an energy distribution curve;

calculating a similarity between the energy distribution curve and a predetermined standard distribution curve corresponding to a valid touch event; and

determining, based on the similarity, whether the sound matches the valid touch event.

6. The method according to claim 1, wherein before the capturing, through a bone conduction microphone deployed on the near field communication device, a sound generated due to the touch, the method further comprises:

detecting a surrounding environmental electromagnetic signal;

determining, based on the environmental electromagnetic signal, whether environmental electromagnetic interference exceeds a predetermined degree; and

if yes, starting the bone conduction microphone deployed on the near field communication device, so that the bone conduction microphone is in a sound capture state.

7. The method according to claim 1, wherein the touch action is performed by the user by using one of a plurality of different prompted touch modes, the matched event is a touch event corresponding to the one touch mode, and the plurality of different touch modes respectively correspond to different touch events; and

the correspondingly executing a near field communication-based service for the mobile terminal based on the event specifically comprises:

determining and executing a near field communication-based service corresponding to the corresponding touch event in a plurality of different near field communication-based services, wherein

the plurality of different near field communication-based services respectively correspond to different touch events.

8. The method according to claim 1, wherein the capturing a sound generated due to the touch specifically comprises:

capturing a sound made by the touch, and capturing a sound of audio that the mobile terminal is triggered to additionally play due to the touch, wherein

the audio is played by the mobile terminal in the following manner: determining whether a specified auxiliary sound generation switch is in an on state, and automatically playing the audio corresponding to the touch if the touch is detected in the on state.

9. The method according to claim 8, wherein the audio prompts the near field communication-based service through voice.

10. The method according to claim 1, wherein the event is a valid touch event; and

the correspondingly executing a near field communication-based service for the mobile terminal based on the event specifically comprises:

controlling, in response to the valid touch event, a near field communication signal of the near field communication device and/or a near field communication signal of the mobile terminal to be enhanced, and executing a service based on an enhanced near field communication signal.

11. The method according to any one of claims 1 to 10, wherein the service comprises a payment service.

12. A near field communication-based service processing apparatus, applied to a near field communication device of a service provider, wherein the apparatus comprises:

a touch sound capture module, configured to capture, through a bone conduction microphone deployed on the near field communication device in response to an action of moving, by a user, a mobile terminal to approach and touch the near field communication device, a sound generated due to the touch;

a touch sound detection module, configured to detect the sound to determine an event that matches the sound; and

a near field communication service execution module, configured to correspondingly execute

a near field communication-based service for the mobile terminal based on the event.

13. The apparatus according to claim 12, wherein the touch sound capture module is configured to capture, through the bone conduction microphone deployed inside a housing of the near field communication device in response to an action of moving, by the user, the mobile terminal to approach and touch a specified near field communication sensing region on the near field communication device, a sound generated due to the touch, wherein the bone conduction microphone is located below the near field communication sensing region.

14. The apparatus according to claim 13, wherein the bone conduction microphone is located in a soundproof sealed cavity disposed below the near field communication sensing region; and

the soundproof sealed cavity is formed through enclosing by a part of the housing of the near field communication device and a shock-absorbing sealing material surface deployed inside the housing of the near field communication device, and the bone conduction microphone is in contact with an inner surface of the part of the housing.

15. The apparatus according to claim 12, wherein the touch sound detection module is configured to: perform time domain analysis on the sound, and collect statistics on short-time window energy by using a short-time window of a specified length, to obtain a plurality of corresponding short-time window energy frames;

collect statistics on an inter-frame energy rise rate and/or an inter-frame energy fall rate of the plurality of short-time window energy frames; and

if the inter-frame energy rise rate is less than a specified rise threshold, and/or if the inter-frame energy fall rate is greater than a specified fall threshold, determine that the sound matches an invalid touch event.

16. The apparatus according to claim 15, wherein the touch sound detection module further performs the following operations:

if it is determined, based on the inter-frame energy rise rate and the inter-frame energy fall rate, that the sound does not match the invalid touch event, performing frequency domain analysis on the sound;

converting a time domain signal of the sound into a frequency domain signal, and performing division to obtain a plurality of frequency bands;

collecting statistics on energy of the frequency domain signal on each of the frequency bands to generate an energy distribution curve;

calculating a similarity between the energy distribution curve and a predetermined standard distribution curve corresponding to a valid touch event; and

determining, based on the similarity, whether the sound matches the valid touch event.

17. The apparatus according to claim 12, wherein before the capturing, through a bone conduction microphone deployed on the near field communication device, a sound generated due to the touch, the apparatus further comprises:

detecting a surrounding environmental electromagnetic signal;

determining, based on the environmental electromagnetic signal, whether environmental electromagnetic interference exceeds a predetermined degree; and

if yes, starting the bone conduction microphone deployed on the near field communication device, so that the bone conduction microphone is in a sound capture state.

18. The apparatus according to claim 12, wherein the touch action is performed by the user by using one of a plurality of different prompted touch modes, the matched event is a touch event corresponding to the one touch mode, and the plurality of different touch modes respectively correspond to different touch events; and

the near field communication service execution module is configured to determine and execute a near field communication-based service corresponding to the corresponding touch event in a plurality of different near field communication-based services, wherein

the plurality of different near field communication-based services respectively correspond to different touch events.

19. The apparatus according to claim 12, wherein the touch sound capture module is configured to capture a sound made by the touch, and capture a sound of audio that the mobile terminal is triggered to additionally play due to the touch, wherein

the audio is played by the mobile terminal in the following manner: determining whether a specified auxiliary sound generation switch is in an on state, and automatically playing the audio corresponding to the touch if the touch is detected in the on state.

20. The apparatus according to claim 19, wherein the audio prompts the near field communication-based service through voice.

21. The method according to claim 12, wherein the event is a valid touch event; and

the near field communication service execution module is configured to: control, in response to the valid touch event, a near field communication signal of the near field communication device

and/or a near field communication signal of the mobile terminal to be enhanced, and execute a service based on an enhanced near field communication signal.

22. The apparatus according to any one of claims 12 to 21, wherein the service comprises a payment service.

23. A near field communication-based service processing device, applied to a near field communication device of a service provider, wherein the service processing device comprises a bone conduction microphone-based sound capture module, an event detection module, and a near field communication control module;

the bone conduction microphone-based sound capture module is configured to capture, through a bone conduction microphone deployed on the near field communication device in response to an action of moving, by a user, a mobile terminal to approach and touch the near field communication device, a sound generated due to the touch;

the event detection module is configured to detect the sound to determine an event that matches the sound; and

the near field communication control module is configured to correspondingly execute a near field communication-based service for the mobile terminal based on the event.

24. The service processing device according to claim 23, further comprising a housing and a soundproof sealed cavity, wherein

the bone conduction microphone is located in the soundproof sealed cavity disposed below the near field communication sensing region; and

the soundproof sealed cavity is formed through enclosing by a part of the housing and a shock-absorbing sealing material surface deployed inside the housing, and the bone conduction microphone is in contact with an inner surface of the part of the housing.

25. A near field communication-based service processing device, applied to a near field communication device of a service provider, wherein the service processing device comprises:

at least one processor; and

a storage communicatively connected to the at least one processor, wherein

the storage stores instructions executable by the at least one processor, and the instructions are executed by the at least one processor to enable the at least one processor to perform the following operations:

capturing, through a bone conduction microphone deployed on the near field communication

device in response to an action of moving, by a user, a mobile terminal to approach and touch the near field communication device, a sound generated due to the touch;

detecting the sound to determine an event that matches the sound; and

correspondingly executing a near field communication-based service for the mobile terminal based on the event.