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(72) Inventor;
HARDIE-BICK, Anthony Richard [GB/GB]; 18 Dalmeny Court, 8 Duke Street, St James',
London SW1Y 6BL (GB).


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(54) Title: APPARATUS AND METHOD FOR INITIATING DATA TRANSFER

Figure 9

(57) Abstract: A method is disclosed for initiating a data transfer between a first communicating apparatus (101) and a second communicating apparatus (901). Each said communicating apparatus includes an impact detector (110) and a wireless data transceiver (107). The first communicating apparatus detects impacts and receives impact data from the second communicating apparatus. Detected impacts (403) are compared with received impact data (402) in order to identify a mutual impact. Preferably a sequence of two mutual impacts is identified. A transfer of data (307) is initiated in response to the identification of a mutual impact.
Apparatus and Method for Initiating Data Transfer

Field of the Invention
The present invention relates to apparatus and a method for initiating a data transfer, and in particular relates to initiating a data transfer over a wireless connection.

Background of the Invention
Portable computing devices such as mobile phones are able to communicate wirelessly using a variety of methods, including GSM/3G telephony, WiFi, Bluetooth and NFC systems. Bluetooth can be used to connect portable devices, such as hands-free headsets with mobile phones, and so on. It is possible to share data over such connections, including address book data, photographs and documents, and it is fairly easy to transfer information between a phone and a laptop computer or other device, once a connection has been set up. However, it takes time to set up a connection, sometimes up to half a minute or so, due to the necessity of navigating some kind of user interface.

NFC is a proximity-based wireless connection system which can be used with Bluetooth to more quickly establish a connection. NFC-equipped devices automatically establish a connection when placed within a few inches of each other, and data exchanged over NFC can be used to establish a Bluetooth connection in less than a second. This gestural aspect has the potential to improve ease of use considerably. However, NFC is an expensive way of fixing a shortcoming with an otherwise successful technology. Also, proximity-based wireless systems such as NFC can make connections unintentionally, through bags and clothing, which raises concerns about the security of this solution.

Generally speaking, wireless communication is extremely useful for all kinds of data transfer, but setting up a connection requires user-intervention. This limits the ease of use of ad-hoc data connections made using Bluetooth
and other such systems. In particular, a limitation exists in the speed at which connections can be made between devices which have not been connected before. Many users find the connection procedures intimidating. The cost of known solutions to these problems prevents their widespread adoption.

Summary of the Invention

According to an aspect of the invention, there is provided a communicating apparatus for initiating a data transfer, the communicating apparatus including an impact detector, a wireless data transceiver, and a processor connected to the impact detector and the wireless data transceiver, the processor being configured to perform the steps of processing signals from the impact detector to generate detected impact data, receiving impact data from a second communicating apparatus via the wireless data transceiver, identifying a mutual impact by comparing the detected impact data with the received impact data, and, if a mutual impact is identified, initiating a data transfer with the second communicating apparatus.

Brief Description of the Drawings

Figure 1 shows a mobile phone;

Figure 2 details main components of the mobile phone shown in Figure 1, including a non-volatile memory and a random access memory;

Figure 3 details contents of the non-volatile memory shown in Figure 2, including data transfer instructions;

Figure 4 details contents of the random access memory shown in Figure 2;

Figure 5 details the data transfer instructions shown in Figure 3, including a step for detecting impacts and receiving impact data, and a step for identifying mutual impacts;

Figure 6 details the step of detecting impacts and receiving impact data shown in Figure 5;

Figure 7 details the step of identifying mutual impacts shown in Figure
5, including a step of comparing time differences;

Figure 8 illustrates the step of comparing time differences shown in Figure 7;

Figure 9 illustrates an application of the mobile phone shown in Figure 1;

Figure 10 summarises the application shown in Figure 9;

Figure 11 shows a smart card;

Figure 12 details components of the smart card shown in Figure 11, including non-volatile memory and random access memory;

Figure 13 details contents of the non-volatile memory shown in Figure 12, including data transfer instructions;

Figure 14 details contents of the random access memory shown in Figure 12;

Figure 15 details the data transfer instructions shown in Figure 13;

Figure 16 shows a point of sale (POS) terminal;

Figure 17 details components of the POS terminal shown in Figure 16, including a solid state drive and random access memory;

Figure 18 details the contents of the solid state drive shown in Figure 17, including location-dependent data transfer instructions;

Figure 19 details the contents of the random access memory shown in Figure 17;

Figure 20 details the location-dependent data transfer instructions shown in Figure 18, including a step of selecting a preferred data transfer function;

Figure 21 details the step of selecting a preferred data transfer function shown in Figure 20;

Figure 22 illustrates an application of the point of sale terminal shown in Figure 16 and the smart card shown in Figure 11;

Figure 23 illustrates an additional application of the smart card shown in Figure 11;

Figures 24 to 36 illustrate an application of the point of sale terminal
shown in Figure 16 with the mobile phone shown in Figure 1;

Figure 27 shows a USB connectable device for enhancing wireless connectivity in general purpose computing devices having USB connectors; and

Figure 28 provides a schematic diagram of the USB device shown in Figure 27.

**Detailed Description of the Preferred Embodiments**

An example of a communicating apparatus is shown in Figure 1. Mobile phone 101 includes several components. These include a plastic case 102, a voice microphone 103, a loudspeaker 104, a circuit board 105, a battery 106, a Near Field Communications (NFC) antenna 107, a Bluetooth antenna 108 and a GSM/3G antenna 109. There are also an impact detector, which in this example is a piezo-electric impact sensor 110, and a transmission button 111. The impact sensor 110 is a piezo-electric transducer fixed to the case 102 of the phone, thereby forming a contact microphone. Impacts made by an object against any part of the case 102 are transmitted as sound waves through the case 102 and other components to the impact sensor 110. These impact sound waves are converted into electrical signals by the piezo-electric impact sensor 110.

A functional block diagram of the main components of the mobile phone 101 shown in Figure 1 is detailed in Figure 2. The circuit board 105 includes a processor provided by main processor 201. The main processor 201 is connected to volatile memory (RAM) 202, non-volatile writeable memory (FLASH) 203, a Subscriber Identity Module (SIM) interface 204, a GSM/3G transceiver 205, a Bluetooth transceiver 206, an NFC transceiver 207 and an analogue input output (I/O) circuit 208. The processor 201 is also connected to buttons 209, including the transmit button 111 shown in Figure 1, and displays 210, including two liquid crystal displays (LCDs) and several light emitting diodes (LEDs). A SIM card 211 provides the service-subscriber key used to identify a subscriber to a GSM/3G telephony service provider. The analogue
I/O circuit 208 provides analogue to digital conversion for signals from the impact sensor 110 and the voice microphone 103. The analogue I/O circuit 208 also provides digital to analogue conversion for the loudspeaker 104 and an activation signal for a vibrating alert device 212.

The GSM/3G transceiver 205 provides mobile telephony connections for voice and data over cellular telephony networks. The Bluetooth transceiver 206 facilitates voice and data connections with devices over a short range of a few metres, such as a hands-free headset or a laptop computer. Technical documentation for the Bluetooth standard may be obtained at http://www.bluetooth.com. The NFC transceiver 207 receives and transmits data over very short distances of a few inches via an inductive loop antenna 107. NFC specifications are available from


and


In this example the Bluetooth transceiver 206 embodies the wireless data transceiver used to facilitate a data transfer with another communicating apparatus. However, one of the other transceivers may be used, or another type of transceiver.

The contents of the non-volatile FLASH memory 203 shown in Figure 2 are detailed in Figure 3. A Symbian™ operating system 301 provides processing instructions for hardware device abstraction and common functions. These instructions are executed by the processor 201 shown in Figure 2. GSM/3G instructions 302 are used by the processor 201 to access telephony functions provided by the GSM/3G circuit 205. Bluetooth instructions 206 facilitate data and voice transmissions over a range of up to a few metres using the Bluetooth circuit 206. NFC instructions 504 facilitate data transmission over short ranges of up to a few inches using the NFC circuit 207.

Data transfer instructions 305 enable the processor 201 to perform processing of impacts detected by the impact sensor 110, and initiate data
transfers when certain requirements are met.

Processing instructions are provided for several applications 306 that are usually available on a mobile phone, including a phone book. The non-volatile memory 203 stores valued data 307, including the phone number 308 of the phone 101, the name 309 of the user of the phone and optional data 310. Optional data 310 includes an image of the phone user. These three data items: phone number 308, name 309 and optional data 310 are considered as valued data 307. It is helpful if this valued data 307 can be transmitted to other people very easily, but only when this is appropriate. Phone book data 311 includes phone numbers, names, email addresses and other contact information for other people. The mobile phone 101 also stores video, image and music files 312 in the non-volatile memory 203.

When the mobile phone 101 is switched on, the processor 201 copies instructions from the non-volatile FLASH memory 203 into the random access memory (RAM) 202, and also creates data structures suitable for fast access to certain information. The contents of the RAM 202 are shown in Figure 6. These include: operating system instructions 301, GSM/3G instructions 302, Bluetooth instructions 303, NFC instructions 304, the Data Transfer instructions 305, and application instructions 306.

The data structures held in RAM 202 include a list of probable mutual impacts 401, received impact data 402 and detected impact data 403. Data structures 401 to 403 are created and used by the data transfer instructions 305. Valued data 307 is also present in RAM 202. Other data 404 includes all other data and data structures used by processing instructions 301 to 306.

The data transfer instructions shown in Figures 3 and 4 are detailed in Figure 5. At step 501 the processor halts the processing thread for the data transfer instructions 305 and waits until the transmission button 111 is pressed by the user. At step 502 the phone's display is updated to indicate that the phone is ready to transmit valued data 307. At step 503, devices with which a data transfer can be made are identified on local wireless networks, including Bluetooth and or NFC. In practice, awareness of such devices is provided by a
separate background processing thread initiated by the operating system 301. However, for the purposes of clarity of this description, these steps are shown here in a linear sequence. Steps 504, 505 and 506 are also performed in a non-sequential manner, using multiple processing threads, and again, these are presented in a linear sequence to clarify the description. Those skilled in the art will be able to translate this description into suitably optimised processing instructions.

At step 504, impacts are detected by the impact sensor 110 and associated circuitry 208. The detected impacts are impacts which occur between part of the phone 101 and other objects, including another mobile phone or communicating device. Sound waves resulting from an impact anywhere on the phone 101 are transmitted through its case 102 and other components to the piezo electric impact detector 110. The impact detector 110 generates electrical signals which are digitized by the analogue I/O circuit 208, and then supplied as a stream of audio samples to the processor 201. The processor 201 checks the audio samples to see whether the sample amplitude is high enough to indicate a possible impact. When high amplitude samples are detected, the start time of the high amplitude samples is recorded, and this is stored as detected impact data 303, shown in Figure 3.

Simultaneously with impact detection, step 304 also includes receiving impact data from other communicating devices. Another communicating device, containing an impact sensor and suitable processing circuitry, can transmit data describing an impact to the phone 101, and this impact data is received at step 504 and stored in RAM 202 as received impact data 402. Whenever a local impact is detected, a description of this impact, based on the detected impact data 403, is transmitted to the communicating devices identified in step 503. These three operations - detecting impacts, receiving impact data and transmitting detected impact data - are performed in parallel at step 504. Step 504 may be considered as a data gathering process.

At step 505, mutual impacts are identified by comparing detected impact data 403 with received impact data 402. A mutual impact is one where
the phone 101 physically contacts another communicating device. Sound waves are generated in both at the moment of impact. These sound waves are translated into signals by impact detecting sensors on the phone and the other communicating device. The operations carried out can be the same viewed from either.

In order to detect a mutual impact, one of the communicating devices must transmit a description of an impact to the other communicating device, which can compare the description with locally detected impacts. If these match sufficiently, then it is known that the communicating devices have mutually impacted each other.

In practice, it is preferable to identify a short sequence of two mutual impacts, to ensure that the two communicating devices are being deliberately tapped together.

At step 506, a data transfer is initiated with the communicating device with which a mutual impact has been made. The data transferred is the valued data 307, including the phone number 308, name 309 and optional data 310.

At step 507 any valued data received from the other communicating device is displayed, with an option to store this data in the phone book 311. This received valued data is displayed for a short time and then automatically stored for later access. Several received numbers may be queued for later storage in the phone book 311. User interaction is not necessary for valued data transfer to occur. At step 508, the phone display is automatically reset to its normal appearance.

In summary, the impact detector 110 supplies analogue impact signals to the analogue I/O circuit 208. The processor 201 processes digitized impact signals from the analogue I/O circuit 208 to generate detected impact data 403. Impact data is received by the Bluetooth circuit 206 via the Bluetooth antenna 108 and supplied to the processor 201, which stores it as received impact data 402. A mutual impact is identified by comparing, at step 505, the detected impact data 403 with the received impact data 402, and, if a mutual
impact is identified, a data transfer is initiated at step 506.

The step 504 of detecting impacts and receiving impact data shown in Figure 5 is detailed in Figure 6. At step 601 the processor 201 continuously examines audio data samples from the impact sensor 110 until an impact with the phone 101 is detected. This is done at the same time as a number of other threads executing on the processor 201. At step 602 the detected impact is stored in RAM as detected impact data 403, and this data is also transmitted to other communicating devices with which a mutual impact may have been made. Steps 601 and 602 are looped. A second processing thread is formed by steps 603 and 604, which operate in parallel with steps 601 and 602. Impact data is received from other communicating devices at step 603, and at step 604 this is stored as received impact data 402 in RAM 202.

The step 505 of identifying mutual impacts shown in Figure 5 is detailed in Figure 7. Two parallel processing threads are used. The first thread comprises steps 701 to 705, and has the effect of identifying probable mutual impacts which are stored in the list of probable mutual impacts 401 in RAM 202. The second thread comprises steps 706 to 709 and has the effect of confirming mutual impacts.

At step 701, a detected impact is selected from the detected impact data 403. Steps 702 to 705 are then used to compare the detected impact with any received impact data 402. At step 702 an impact described in the received impact data 402 is selected. At step 703, the start times of the detected impact and the received impact data are compared. If they are similar, pointers to the detected impact and the received impact are stored at step 704 in the list of probable mutual impacts 401, along with the device identity (ID) associated with the received impact, which describes which of several possible communicating devices the received impact data was transmitted from.

Start times of mutual impacts are unlikely to match precisely because the identification of start times according to a common timebase is extremely difficult in practice. A first problem relates to the establishment of absolute real time. A communicating device such as the phone 101 usually includes a real
time clock, but this may differ by many minutes or hours from a real time clock on another phone; there is no guarantee that it has been set correctly. Some communicating devices, such as smart cards, may only have an elapsed time clock, and are unable to provide an absolute time measurement at all. A second problem relates to communications protocols such as NFC and Bluetooth. Data transmitted through these wireless protocols has a delay which varies in the range of one or two milliseconds to several tens of milliseconds. This delay, known as communications latency, occurs as a result of interactions between the transceiver and the operating system, and is usually unpredictable. The operating system 301 imposes additional delays of its own, typically in the order of a few milliseconds. Although it may be theoretically possible to implement a system in which delay times are more precisely known, this could be extremely difficult. However, in order to confirm a mutual impact, accuracy of a few milliseconds is required.

Steps 706 to 709 implement a solution. At step 706 the list of probable impacts 401 is scanned to identify a pair of sequential mutual impacts with the same communicating device. The sequence must be less than three quarters of a second in duration, within which a double impact sequence is considered intentional. The sequence must also be greater than 150 milliseconds, to ensure that the double impact is deliberate. At step 707 start times for the locally detected impacts, TL1 and TL2, are subtracted to obtain a local time difference TLD. At step 708 the same operation is performed for the received impact data, where the received start times TR2 and TR1 are subtracted to obtain a received time difference TRD. TR1 and TR2 are transmitted as part of the received impact data, and are measured by an elapsed time clock on the communicating device. This provides a high level of accuracy even though the absolute times are unknown. At step 709 the local and received time differences are compared. If the difference between these is less than 3 milliseconds, then a confirmed sequence of two mutual impacts is identified. Using differences rather than absolute values improves the level of discrimination which can be applied when deciding whether or not a mutual
impact has occurred.

A graphical illustration of the identification of a double mutual impact is shown in Figure 8. Here it can clearly be seen that TLD and TRD will be very similar when a double mutual impact is made between communicating devices. The variable communications latency 801 does not affect the difference between the local impact time difference TLD and the received impact time difference TRD. Variations of up to 3 milliseconds are tolerated because the acoustic characteristics of a common impact waveform at the two impact sensors on respective communicating devices may be different, affecting the time at which the start of an impact is recorded. Furthermore, the audio sample rate, which is used as the basis of time difference calculation, may also be slightly different on each device.

The effect of the invention is illustrated in Figure 9. The mobile phone 101 is tapped twice against a second mobile phone 901. Phone numbers, names and optional data are automatically exchanged. In this embodiment, as a precautionary measure, users are required to momentarily press the transmission button 111 prior to tapping their phones together, in order to absolutely ensure that any such data exchange is deliberate. However, the act of tapping the phones together initiates the data exchange without any subsequent authorisation being required, thereby facilitating a one-for-one mapping between gesture and function.

The second mobile phone 901 operates substantially in the same way as the first mobile phone 101, as described with reference to Figures 1 to 8. It is not necessary for both phones to transmit valued data. If only one user presses the transmit button 111 on their phone before the phones are tapped together, then only the user who pressed the transmit button 111 transmits their valued data 307. This valued data can then be received by the other phone, even though its transmission button was not pressed. Storage of the received valued data in a phone book or elsewhere is optional.

The operations performed by the users of the two mobile phones 101 and 901 are summarised in Figure 10. Steps 1001 and 1002 are not
necessarily sequential. At step 1001 the first user sets their mobile phone 101 to transmit data such as their phone number 308, name 309 and optional data 310 by pressing the transmission button 111. At step 1002 a second user primes the other mobile phone 901 to do the same. At step 1003 the users tap the phones 101 and 901 against each other twice. At step 1004 the phones 101 and 901 exchange telephone numbers, names and optional information such as images etc. Such valued data 307 must be prevented from being transmitted accidentally.

Several types of attack on Bluetooth and NFC connections are possible, which may result in unauthorised data transmission. A physical impact between communicating devices can be used to initiate data transfer with greater security as well as simplifying many types of data exchange, such as the exchange of phone numbers as described, or electronic business cards. It is assumed that all valued data transactions include encryption to prevent eavesdropping attacks.

Either Bluetooth or NFC can be used to transfer impact data and or valued data. Bluetooth is used by default in the preferred embodiment due to its wide acceptance as a system for data communications. However, NFC is also provided in case communication with devices equipped only with NFC is needed, although in the majority of cases, this will not be the case. Bluetooth has two basic inquiry codes for establishing a connection: the General Inquiry Access Code (GIAC) and the Limited Inquiry Access Code (LIAC). LIAC is used when a short term connection is made, thereby minimizing the number of responding devices that are in range. LIAC is used to establish the Bluetooth connection. A full description of Bluetooth connection procedures is provided at the previously mentioned Bluetooth documentation URL. A summary of these procedures is provided in "Bluetooth Application Developer's Guide", by David Kammer, Gordon McNutt, Brian Senese and Jennifer Bray, ISBN 1-928994-42-3.

The transmission button 111 can be permanently activated by holding it down for more than three seconds. The mobile phone's display is updated to
reflect sustained activation.

In an alternative embodiment the voice microphone 103 may also function as the impact detector, eliminating the need for the two audio transducers 103 and 110. In a further alternative embodiment, the impact detector is provided by a material that changes its resistance in response to pressure upon its surface. Resistance changes are translated into electrical form by the analogue I/O circuit 208 and supplied as impact signals to the processor 201.

The communicating apparatus may be any kind of electronic device capable of communicating wirelessly. Other examples of communicating apparatus include, but are not limited to, smartphones, netbooks, and laptop computers with built-in Bluetooth connectivity. The ability to initiate data transfer in response to mutual impacts can be useful in devices that are very different. In an further alternative embodiment, the communicating apparatus is embodied as a smart card, which includes components and processing instructions to perform mutual impact detection and initiate data transfers.

An improved smart card is shown in Figure 11. The smart card 1101 includes a processor chip 1102, an NFC inductive loop antenna 1103, a capacitor 1104 for storing power derived from signals received by the antenna 1103 and an impact detector, which in this example is impact sensor 1105. The impact sensor 1105 is formed from a metallised piezo electric element 1106 deposited on a brass disc 1107. Impacts with any part of the smart card 1101 result in sound waves being generated which are conducted through the plastic substrate of the smart card 1101 to the piezo-electric element 1106, where they are converted into a varying electrical signal.

The connections made between the various components of the smart card 1101 are shown in Figure 12. The processor chip 1102 includes a processor provided by main processing circuitry 1201, analogue I/O 1202, an NFC circuit 1203, an Electrically Erasable Programmable Read Only Memory (EEPROM) 1204 and Random Access Memory (RAM) 1205. Power derived from the antenna 1103 is stored in the capacitor 1104, which is used as the
power source for the chip 1102. The smart card 1101 is considered a passive communications device, because power is derived from the antenna 1103 when the smart card is placed in close proximity to an active device transmitting an NFC signal. The NFC standard specifies that one of the devices in a communicating pair can be passively powered in this way. Thus a wireless data transceiver is provided in this embodiment by NFC circuit 1203 and the inductive loop antenna 1103. In a smart card of this type, both power and data are supplied to the passive smart card wirelessly via the inductive loop antenna 1103. Thus in this embodiment the wireless data transceiver is a passive transceiver.

The contents of the EEPROM 1204 shown in Figure 12 are detailed in Figure 13. Bootstrap instructions 1301 are executed by the processor 1201 whenever sufficient power is available from the antenna 1103. Bootstrap instructions include instructions to initialise registers in the processor 1201 and various other processor circuits. NFC instructions 1302 facilitate wireless data transfer between the smart card 1101 and another communicating device. Data transfer instructions 1303 facilitate the initiation of a valued data transfer. An application 1304 provides instructions for accessing operational data 1305 and user data 1306 as part of a credit card transaction and other operations.

During operation, the processor 1201 accesses instructions and non-volatile data directly from the EEPROM 1204 without copying them into RAM 1205. The RAM 1205 is used to store transient data. RAM contents are detailed in Figure 14. Application data 1400 is used by the application instructions 1304 during application processing. A list of probable impacts 1401, received impact data 1402 and detected impact data 1403 are generated and modified by the data transfer instructions 1303. Valued data 1404 is generated from user data 1306 and operational data 1305 during processing of application instructions 1304.

Once the application 1304 has generated valued data 1404, the data transfer instructions 1303 are executed on the processor 1201. The data transfer instructions 1303 shown in Figure 13 are detailed in Figure 15, and
comprise steps 504, 505 and 506 which have been described with reference to
Figure 5. There is one difference: steps 504, 505 and 506 are executed in a
continuous loop for as long as power is available. Application instructions 1304
continue in parallel with the data transfer instructions 1303, once these have
started operating. Step 504 detects impacts made with the smart card 1101
that are picked up by the impact sensor 1105 as sound waves transmitted
through the medium of the smart card from the point of impact. These impacts
are stored in RAM 1205 as detected impact data 1403. Also at step 504,
impact data is received from the communications device supplying power to
the smart card. This is stored as received impact data 1402 in RAM 1205.
Detected impact data 1403 is transmitted to the communicating device. Details
of step 504 may be understood with reference to Figure 6 and the
accompanying description.

At step 505 mutual impacts between the smart card 1101 and another
communicating device, such as a card reader, are identified by comparing the
detected impact data 1403 with received impact data 1402. During this
process, the list of probable impacts 1401 is created and processed. Further
details of the processing performed in step 505 are detailed in Figure 7.

At step 506 a valued data transfer is initiated with the device with which
mutual impacts have been made. This valued data transfer is encrypted.

A typical application for the smart card shown in Figure 11 is a secure
credit card transaction, in which a card reader is tapped twice by the smart
card. The operation performed is context dependent, and determined by an
application running on the card reader. The card reader also includes impact
detection circuitry and processing instructions to perform mutual impact
detection as has already been described with reference to the smart card 1101
and the mobile phone 101. Card readers are typically included in point of sale
(POS) terminals such as those used in retail outlets, restaurants and
elsewhere.

A further embodiment of the communicating apparatus is a point of sale
terminal based on a touch sensitive flat screen display, as shown in Figure 16.
The terminal 1601 has a flat panel LCD display 1602. In front of the LCD display is a sheet of glass 1603 upon which are mounted two piezo-electric transducers 1604 and 1605, embodying the impact detector. The piezo transducers 1604 and 1605 pick up the sound of impacts made with the glass 1603 by a finger or other object. The location of impact is determined by comparing phase difference information derived from the two transducers 1604 and 1605 and comparing these with known phase difference profiles for locations on the glass. This method of touch detection is described in United States Patent US 7,411,581 B2 by the present applicant and is available from Elo TouchSystems under the name Acoustic Pulse Recognition (APR). See http://www.elotouch.com/Technologies/AcousticPulseRecognition.

The POS terminal 1601 includes an NFC inductive loop antenna 1606, and is connected to an Internet Service Provider via a network cable 1607. The display shows several icons 1608 to 1615 that correspond to several different products. In this case, each icon represents a different amount of time for wireless Internet access provided in the cafe where the terminal 1601 is located. A menu icon 1616 enables the terminal operator to access other sales screens.

Hardware components of the POS terminal 1601 shown in Figure 16 are detailed in Figure 17. A processor is provided by Central Processing Unit (CPU) 1701, which executes instructions and processes data stored in 1 gigabyte (GB) of RAM 1702. Non-volatile storage is provided by a 32GB Solid State Drive (SSD) 1703. A Bluetooth interface circuit 1704 provides medium range wireless connectivity. A Bluetooth antenna 1705 is included in the terminal casing. An enhanced NFC circuit 1706 facilitates short range data communication up to twenty inches. An enhanced NFC circuit is required so that NFC-based communication devices without Bluetooth, such as the smart card 1101 shown in Figure 11, can interact with the entire area of the terminal display 1603. NFC enhancement is provided by increasing transmission power. In this embodiment the transceiver is formed by the enhanced NFC circuit 1706 and the inductive loop antenna 1606. These provide an active
wireless transceiver for use with the passive transceiver provided by components 1203 and 1103 in the smart card 1101.

An APR interface 1707 converts sound signals from the transducers 1604 and 1605 into a stream of digital audio samples and performs touch location detection. The time of impact detection is also recorded and supplied to the CPU 1701 along with touch or impact location co-ordinates. A graphics card supplies signals to the LCD display 1602. A network interface card provides a connection to the Internet so that cash transactions can be made with the POS terminal. A Universal Serial Bus (USB) I/O circuit 1710 provides USB connections that may be used for connecting a mouse and a keyboard if necessary. However, the POS terminal 1601 is operated primarily by touch and object impacts.

The contents of the SSD 1703 shown in Figure 17 are detailed in Figure 18. These include operating system instructions 1801, Bluetooth instructions 1802, enhanced NFC instructions 1803, APR instructions 1804, location-dependent data transfer instructions 1805 and application instructions 1806. The SSD 1703 also includes network key data 1807 and other data 1808. During operation, instructions shown in Figure 18 are transferred to RAM 1702 and data structures in RAM 1702 are created and initialised.

The contents of RAM 1702 shown in Figure 17 are detailed in Figure 19. These include the operating system instructions 1801, Bluetooth instructions 1802, enhanced NFC instructions 1803, APR instructions 1804, location-dependent data transfer instructions 1805 and application instructions 1900. Data structures relating to the location-dependent data transfer instructions 1805 include a list of probable impacts 1901, received impact data 1902 and detected impact data with locations 1903. Also stored in RAM 1702 are APR data 1904, credit card transaction data 1905, network key data 1906 and other data 1907.

Steps performed by the location-dependent data transfer instructions 1805 shown in Figure 18 are detailed in Figure 20. At step 2001 potential communicating devices on NFC and Bluetooth connections are identified. At
step 2002, impacts with the screen 1603 are detected by the APR instructions 1804. Impact characteristics are stored in RAM 1702 as detected impact data with locations 1903. Also in step 2002, impact data is received from the communicating devices identified at step 2001, and this data is stored in RAM 1702 as received impact data 1902. Also in step 2002, detected impact data 1903 is transmitted to the communicating devices identified in step 2001. These operations are carried out in parallel, as shown in Figure 6, with the slight change that detected impact data stored in RAM 1702 includes data describing the location of the impact on the screen 1603.

In step 2004, mutual impacts are identified by comparing detected impact data 1903 with received impact data 1902. This step creates and modifies the list of probable mutual impacts 1901. The operations carried out in step 2003 are the same as those detailed in Figure 7 and the accompanying description.

At step 2004, a preferred data transfer operation is selected depending on the location on the screen 1603 of a mutual impact between the screen and a communicating device.

At step 2005 the data transfer operation selected at step 2004 is initiated with the communicating device tapped against the screen 1603.

At step 2006 the display 1602 is updated to provide the user with appropriate feedback by momentarily changing the colour of the icon 1608 to 1615 against which the communicating device has been tapped. Thereafter, steps 2001 to 2006 are repeated to continue detection of mutual impact events.

The step 2004 of selecting a preferred data transfer operation shown in Figure 20 is detailed in Figure 21. At step 2101 the average X and Y coordinates of the impact location on the screen 1603 are identified. Two successive impacts are required to initiate data transfer, and these impacts may occur at slightly different locations. The average of the two impact locations is used. At step 2102 a question is asked as to whether there is an application icon at the identified impact location on the display. If an icon is
present, step 2103 obtains the address of a data transfer function from application instructions 1900. At step 2104, it is known that the communicating device was not tapped against an icon, so a default data transfer function address is used.

Location dependence of the data transfer function is a specific instance of the broader concept of context dependence. In the embodiment described with reference to Figures 16 to 21, the context is the location of a mutual impact on the screen 1603, and the data to be transferred is selected at step 2204 based on this context. A mobile phone with a camera may implement a different kind of context dependency. For example, if the user has just taken a photograph using the camera, and is viewing this on the phone’s display, a double tap made in this context will select the photograph for the valued data transfer, instead of the default setting of the user’s name and phone number. In this way, the device’s processor selects data for data transfer in response to the context of a mutually identified impact. The selected data is appropriate to the device and the way it is being used, at the moment when the mutual impact is made. The context may also define whether both communicating devices perform a data transfer, or whether only one device transmits, as would be the case with a photograph.

Data transfer is not restricted to passive data. The data may define a command to be executed on another device. The context in which the data transfer is made ensures an appropriate action is performed on the receiving device. The OBEX protocol can be used over a Bluetooth connection, and this includes commands for file browsing, copying, deletion and so on. All these actions can be described by strings of ASCII data referred to as headers, and which can form part of the data transfer initiated as a result of identifying a mutual impact. Details of the OBEX specification may be obtained from the Infrared Data Association at http://www.irda.org.

The smart card 1101 shown in Figure 11 can be used in an application of the POS terminal 1601 shown in Figure 16. This is illustrated in Figure 22. At step 2201 the smart card 1101 is tapped twice against an icon 1611 in order
to pay for six hours' wireless Internet access. A cash payment is made from
the smart card at step 2202. This is considered a first valued data transfer. At
step 2203 a second valued data transfer is performed, in which the POS
terminal 1601 transmits a wireless network key to the smart card along with
metadata describing the data as a network key. The smart card 1101 is now
considered as being loaded with the network key. The smart card need not
use this data, and it can be safely ignored. However, in this case it is useful.

The user takes the smart card 1101 to a laptop computer 2200 and, at
step 2204, taps it against the case. The laptop computer 2200 is fitted
with impact detection circuitry and contains impact detection instructions as
have already been described. At step 2205 the smart card 1101 initiates a
valued data transfer to the laptop computer 2200. The valued data is the
network key and the metadata that describes it. The laptop computer
automatically supplies the network key to the appropriate application so that
wireless Internet connectivity can be automatically established without any
further user action being necessary.

In a further alternative embodiment, the smart card 1101 does not
include credit card functionality, and simply acts as a data-carrying
intermediary between other devices which are too large to tap together. Figure
23 shows some applications of the smart card 1101 being used as a data
intermediary. A wireless broadband modem router 2301 provides home
Internet access via an ADSL socket 2302. In addition to usual functionality
expected of such a device, it is fitted with impact detection circuitry, impact
detection instructions and NFC wireless connectivity as already described. A
user taps the smart card twice against the case of the router 2301, resulting in
the initiation of a data exchange. The smart card picks up the access key for
the wireless network from the router 2301. The user then takes the smart card
1101 to a desktop computer 2303, also equipped for mutual impact detection
and data transfer initiation as has been described. The impact sensor and
NFC antenna are located in the case of the display 2304. The user taps the
smart card 1101 twice against the case of the display, and the smart card
1101 transmits the access key to the computer 2303, along with metadata describing the access key. The computer 2303 is then able to connect to the wireless router 2301 without the user taking further action. As part of the data exchange, the computer 2303 transmits its wireless network address to the smart card 1101, just in case this is useful. The user is then able to connect a printer 2305 to the computer 2303 by means of a wireless connection by simply tapping the smart card 1101 against the printer 2305. The printer includes impact detection circuitry, instructions and NFC wireless connectivity as already described, in order to facilitate this.

Most devices have a single most appropriate item of data to transmit, which does not require further specification. For example, the most appropriate item for a mobile phone to transmit is the name of its user and the telephone number. The smart card 1101 transmits the last data item it has picked up to the equipment it is being tapped against, and receives a new data item. Metadata describing the data item ensures that it will be appropriately used or ignored by any equipment that subsequently receives it.

An additional application of the terminal 1601 shown in Figure 16 and the mobile phones 101 and 901 shown in Figure 9 is illustrated in Figures 24 to 26. In Figure 24 the mobile phone 901 is tapped against the glass screen of the terminal 1601. The terminal 1601 receives the telephone number and the user's name, along with metadata describing what kind of information this is. An application running on the terminal 1601 receives the phone data and displays this in a desktop icon 2501 in which the user's name and number can be seen. In Figure 26, three such icons are displayed, resulting from three different phones having been tapped against empty parts of the desktop area on the screen 1603. A second mobile phone 101 is tapped against one of these icons 2501 and picks up the number and name. Such an application may be useful for quickly sharing phone numbers between a team of people.

In another embodiment, the communicating apparatus is a Bluetooth dongle which can be plugged into the USB port of any computer. This device is illustrated in Figure 27. The Bluetooth dongle 2710 mostly comprises a USB
plug 2702. The rest of the device includes a Bluetooth transceiver antenna
2703, an integrated circuit 2704 and a piezo-electric transducer 2705 which is
used as the impact detector. The components of the device are shown in
schematic form in Figure 28. The integrated circuit 2704 performs all the main
processing functions, along with analogue to digital conversion, USB
interfacing and radio frequency data communications. A central processor
2801 coordinates the operation of the components of the device. The impact
detector 2705 supplies analogue impact signals to an analogue to digital
converter 2802. The processor 2801 processes digitized impact signals from
the analogue to digital converter 2802 and generates detected impact data.
Impact data is received by a Bluetooth circuit 2803 via the Bluetooth antenna
2703 and supplied to the processor 2801. A mutual impact is identified by
comparing the detected impact data with the received impact data, and, if a
mutual impact is identified, a data transfer via Bluetooth is initiated. In this
case, data is transferred from a source inside the computer to which the
donagle 2701 is connected, via the USB connection 2702. The data transfer is
dependent upon the context of applications running on the computer to which
it is connected. Processing instructions stored on EEPROM 2805 determine
operations carried out by the processor 2801 in order to achieve this task.
RAM 2806 is used for temporarily storing detected impact data and received
impact data, along with buffered amounts of data waiting to be transferred
after a data transfer has been initiated.

The device shown in Figures 27 and 28 facilitates a simple upgrade of
an ordinary laptop or desktop computer so that it can perform mutual impact
initiated data transfers without the need to reconfigure existing hardware, such
as an internal soundcard or integrated Bluetooth functionality which may
already be present.

In the embodiments described, impact detection is performed using
sound transducers such as piezo-electric contact transducers. Other types of
sound transducers may be used, including electromagnetic transducers. In
addition to sound, it is possible that other impact detection techniques may be
used, including accelerometers, switches, interacting conductive films, quantum tunnelling effect, optical, capacitive and resistance-based detection. For example, the POS terminal 1601 could use a resistive layer touch sensing system, in which the conduction between two transparent resistive layers triggers detection of an impact and its location.

The term impact detector includes any device, combination of devices, or technologies for detecting impacts.
Claims

1. A communicating apparatus for initiating a data transfer, said communicating apparatus including an impact detector, a wireless data transceiver, and a processor connected to said impact detector and said wireless data transceiver, said processor being configured to perform the steps of:
   - processing signals from said impact detector to generate detected impact data,
   - receiving impact data from a second communicating apparatus via said wireless data transceiver,
   - identifying a mutual impact by comparing said detected impact data with said received impact data, and
   - if a mutual impact is identified, initiating a data transfer with said second communicating apparatus.

2. Apparatus according to claim 1, wherein said processor is further configured to transmit said detected impact data to said second communicating apparatus via said wireless data transceiver.

3. Apparatus according to claim 1, wherein said impact detector is a microphone.

4. Apparatus according to claim 1, wherein said processor is configured to perform said step of identifying a mutual impact by comparing impact times.

5. Apparatus according to claim 1, wherein said processor is configured to identify a mutual impact by comparing a difference between a first and a second impact in said detected impact data with a difference between a first and a second impact in said received impact data.
6. Apparatus according to claim 5, wherein said differences are time differences.

7. Apparatus according to claim 1, wherein said impact detector is a microphone whose primary purpose is not impact detection.

8. Apparatus according to claim 1, wherein said impact detector is configured to generate impact location signals.

9. Apparatus according to claim 1 or claim 8, wherein said processor is configured to select data for said data transfer in response to the context of a mutually identified impact.

10. Apparatus according to any of claims 1 to 9, wherein said apparatus is a mobile telephone.

11. A method of initiating a data transfer between a first communicating apparatus and a second communicating apparatus, comprising steps performed by said first communicating apparatus of:

   detecting an impact and generating detected impact data,
   receiving impact data from said second communicating apparatus,
   identifying a mutual impact by comparing said detected impact data with said received impact data, and

   if a mutual impact is identified, initiating a data transfer with said second communicating apparatus.

12. A method according to claim 11, further including the step of transmitting said detected impact data to said second communicating apparatus.
13. A method according to claim 11, wherein said step of detecting an impact is carried out using a microphone.

14. A method according to claim 11, wherein said step of identifying a mutual impact comprises comparing impact times.

15. A method according to claim 11, wherein said step of identifying a mutual impact comprises comparing a difference between a first and a second impact in said detected impact data with a difference between a first and a second impact in said received impact data.

16. A method according to claim 15, wherein said differences are time differences.

17. A method according to claim 11, wherein said step of detecting an impact is carried out using a microphone whose primary purpose is not impact detection.

18. A method according to claim 11, wherein said step of generating mutual impact location data comprises processing impact detector signals.

19. A method according to claim 11 or claim 18, further including the step of selecting data for said data transfer in response to the context of a mutually identified impact.

20. A method of initiating a data transfer between mobile phones according to any of claims 11 to 19.
### Figure 3

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### Figure 4

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</table>
WAIT UNTIL TRANSMISSION BUTTON 111 IS Pressed

UPDATE DISPLAY TO INDICATE THAT PHONE IS READY TO TRANSMIT VALUED DATA 307

IDENTIFY POTENTIAL COMMUNICATING DEVICES ON WIRELESS NETWORKS (NFC, BLUETOOTH)

DETECT IMPACTS AND RECEIVE IMPACT DATA FROM COMMUNICATING DEVICES, AND TRANSMIT IMPACT DATA TO COMMUNICATING DEVICES

IDENTIFY MUTUAL IMPACTS BY COMPARING DETECTED IMPACTS WITH RECEIVED IMPACT DATA

INITIATE DATA TRANSFER WITH COMMUNICATING DEVICE WITH WHICH MUTUAL IMPACTS WERE MADE

DISPLAY ANY DATA RECEIVED WITH OPTION TO STORE IN PHONE BOOK 311

RESET DISPLAY

Figure 5
WAIT UNTIL AN IMPACT IS DETECTED

STORE DETECTED IMPACT DATA IN RAM AND TRANSMIT TO OTHER COMMUNICATING DEVICES

RECEIVE IMPACT DATA FROM OTHER COMMUNICATING DEVICES

STORE RECEIVED IMPACT DATA IN RAM

Figure 6
Figure 7
Figure 8

TRD = TLD ± 3mS

VARIABLE COMMUNICATIONS LATENCY
Figure 9
FIRST USER PREPARES MOBILE PHONE 101 TO TRANSMIT PHONE NUMBER, NAME AND OPTIONAL DATA 1001

SECOND USER PREPARES MOBILE PHONE 901 TO TRANSMIT PHONE NUMBER, NAME AND OPTIONAL DATA 1002

USERS TAP MOBILE PHONES AGAINST EACH OTHER TWICE 1003

MOBILE PHONES 101 AND 901 EXCHANGE TELEPHONE NUMBERS, NAMES AND OPTIONAL INFORMATION (IMAGES ETC) 1004

Figure 10
DETECT IMPACTS AND RECEIVE IMPACT DATA FROM COMMUNICATING DEVICE, AND TRANSMIT DETECTED IMPACT DATA TO COMMUNICATING DEVICE

IDENTIFY MUTUAL IMPACTS BY COMPARING DETECTED IMPACT DATA WITH RECEIVED IMPACT DATA

INITIATE VALUED DATA TRANSFER WITH DEVICE WITH WHICH MUTUAL IMPACTS WERE MADE

Figure 15
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**Figure 19**

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<td>ENHANCED NFC</td>
<td>BLUETOOTH</td>
<td>OPERATING SYSTEM</td>
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</tr>
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**Figure 18**
Figure 20

1. Identify potential communicating devices on NFC or Bluetooth networks.
2. Detect impacts and receive impact data from communicating devices, and transmit impact data to communicating devices.
3. Identify mutual impacts by comparing detected impacts with received impact data.
4. Select preferred data transfer operation depending on the location of mutual impacts on the screen.
5. Initiate data transfer with communicating device tapped against the screen.
6. Update display appropriately.
Figure 21

1. Identify average X & Y co-ordinates of impact locations on screen 1603.

2. Application icon at impact location?
   - Yes: Obtain data transfer function address from the application.
   - No: Obtain default data transfer function address.
USER TAPS SMART CARD 1101 AGAINST "6 HOUR" NETWORK KEY ICON 2201

CASH PAYMENT IS MADE FROM SMART CARD 2202

SMART CARD IS LOADED WITH NETWORK KEY 2203

USER TAPS SMART CARD 1101 AGAINST CASE OF LAPTOP 2204

NETWORK KEY IS LOADED INTO LAPTOP 2205

Figure 22
A. CLASSIFICATION OF SUBJECT MATTER

INV. H04M1/725 H04W76/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04M H04W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

See patent family annex

- Special categories of cited documents

“A” document defining the general state of the art which is not considered to be of particular relevance

“E” earlier document but published on or after the international filing date

“L” document which may throw doubts on novelty or which is cited to establish the publication date of another document or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“A” document member of the same patent family

Date of the actual completion of the international search

10 December 2009

Date of mailing of the international search report

17/12/2009

Name and mailing address of the ISA/

European Patent Office, P B 5818 Patentlaan 2

NL - 2280 HV Rijswijk

Tel (+31-70) 340-2040, Fax (+31-70) 340-3018

Authorized officer

Lindberg, Per
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