FORM 2

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COMPLETE SPECIFICATION
(See Section 10 and Rule 13)

1 **TITLE OF THE INVENTION :**

A CARD READER DEVICE AND METHOD OF USE.

2 **APPLICANT (S)**

(A) Name : **GUPTA, NALIN;**

Nationality : An Indian National;

Address : B-111, RK Hall of Residence, IIT Kharagpur, Kharagpur-721302, West Bengal, India

(B) Name : **GUPTA, SHAILESH;**

Nationality : An Indian National;

Address : C-109, Azad Hall of Residence, IIT Kharagpur, Kharagpur-721302, West Bengal, India

3 **PREAMBLE TO THE DESCRIPTION**

COMPLETE

The following specification particularly describes the invention and the manner in which it is to be performed.

FIELD OF THE INVENTION:

The present invention is directed to a card reader device for reading a card having data stored on a magnetic stripe and system for different transaction and operation based on information stored on magnetic stripe. More specifically, the present invention is directed to provide a card reading device which is adapted to be used in conjunction with other electronic device including mobile phone, computer, PDA etc. enabling unidirectional or bi directional communication link with the associate electronic devices or media. The companion electronic media or device includes an appropriate assembly of hardware or software or both adapted to perform transactions and/or operations based upon the information retrieved from the magnetic stripe. The present card reader device is further adapted to encrypt the data obtained from the magnetic stripe during the transmission.

BACKGROUND OF THE INVENTION:

Plastic cards having magnetic stripe embedded on them are prevalent in everyday commerce in the form of credit cards, ATM cards, and debit cards. The magnetic stripe is capable of storing data by modifying the magnetism of the magnetic particles embedded on the stripe. The magnetic stripe contains one or more tracks of data.

Magnetic stripe cards are typically read by point-of-sale devices at the merchant's location to make payments. However, there is no simple way to use a card to make payment to an individual who is not a merchant. Therefore, it will be desirable to have a simple card reader device that can be attached to pervasive devices like mobile phones, PDA etc (which are normally available at an individual's disposal), and thereby, allow an individual to make a payment through a magnetic card.

US patent 7810729 B2 describes one such device. However, the device disclosed in this disclosure simply sends the waveform generated by swiping action of the card against the read head to the companion device. There is no way of protecting the data by encryption or like means. Moreover, the companion device cannot send instructions to the card reader device to perform specific operations. Another drawback of the above card reader is that it sends signals of separate tracks along

separate stereo microphone input lines, and so can't be used with companion devices having single microphone input line.

Thus there has been a always need for a Magnetic stripe card reader device which is adaptable to be used in conjunction with pervasive devices like companion device such as a mobile phone, PDA etc which are normally available at an individual's disposal and setup a two way link with the companion device so that the reader device can perform specific operations depending on the instruction received from the companion device. Further the reader device should be capable to encrypt the digital information before transmission to offer better data security.

OBJECTS OF THE INVENTION:

It is thus the basic object of the present invention is to develop a magnetic card reader device to be used in conjunction with a companion device which may be an electronic media such as a mobile phone, computer, PDA etc.; where the device reads the data stored on magnetic stripe card and sends it to the companion device for further use

A further object of the invention is to provide a magnetic card reader device that senses and decodes the data incorporated on a magnetic stripe card, and communicates the same to a companion device via an output jack adapted to be inserted into the microphone input line of the later. Optionally, information may also be transferred from the companion device to the device via use of jack such as a headset jack which also makes contact with the audio line of the companion device.

Another object of the present invention is to provide a magnetic card reader device by which data sensed from a magnetic card stripe may be send in either encrypted or unencrypted form to a companion device via an output jack adopted to be inserted into their microphone input line

Another object of the present invention is to provide a magnetic card reader device that can perform bi-directional communication with companion device such as mobile phones, computer, PDA etc. through their headset port or through their audio and microphone input ports.

A further object of the present invention is to provide a magnetic card reader device that is portable and can easily be attached to a companion device through their headset port or through their audio and microphone ports provided in them

Another object of the present invention is to provide a flexible cable connector attached to the magnetic card reader device, cable terminating into an output jack or into a pair of audio and microphone plugs, so that the magnetic card reader device may be placed at a location convenient to the user swiping the card

Another object of the present invention is to provide a magnetic card reader device that can read one or more tracks of data stored on magnetic stripe card.

Another object of the present invention is to provide a magnetic card reader device that extracts power from the audio interface of the companion device for its functioning. In an alternate embodiment, the magnetic card reader device may use its own separate power source, such as a battery or an adaptor.

A further object of the invention is to provide for advancement in the method of use of magnetic card reader device in conjunction with a companion device such as mobile phone, computer, PDA etc. where the magnetic card reader device senses and decodes the data incorporated on magnetic stripe card and sends it to a companion device via an output jack.

A further object of the invention is to provide a method and means for communication between a magnetic card reader device and the companion device such as a mobile phone, computer, PDA etc. In one form, bi-directional communication between the magnetic card reader device and the companion device for exchange of instructions and data is achieved where the communication is through an output jack such as headset plug or through a pair of audio and microphone plugs. In alternate form,

only one-direction communication is sufficient involving transfer of magnetic stripe data from the magnetic card reader device to the companion device through its microphone input line

Another object of the invention is to develop a magnetic card reader device which can be used as a Point-of-sale device.

Another object of the invention is to develop a magnetic card reader adaptable to be used in conjunction with a companion device such as mobile phone to read a credit card and then use these card details for making a payment or peer-to-peer money transfer.

SUMMARY OF THE INVENTION:

Thus according to the basic aspect of the present invention there is provided a magnetic card reader device for reading information stored on magnetic stripe card comprising of means to swipe or register a card having a magnetic stripe; reading head adapted to generate a signal or waveform that is representative of the data encoded on the magnetic stripe; decoding means adapted for converting the signal or waveform into a digital bit stream; means for converting digital bit stream into digital data and optionally encrypting the converted digital data; means adapted to establish operative communication link with a companion electronic device and to facilitate the transmission of the digital data and a power unit adapted to provide power for the functioning of the magnetic card reader.

According to another aspect in the magnetic card reader device, the means adapted for establishing operative communication with the companion electronic device like mobile phone, computer, laptop, PDA etc comprise an output jack is customized to be inserted into a microphone or audio input plug input line of a companion electronic device.

According to yet another aspect in the magnetic card reader device, the means adapted for establishing operative communication involves a signal setting unit adapted to setup unidirectional or bidirectional communication link between the reader device and the companion device comprising.

According to another aspect in the magnetic card reader device, the input plug of the companion device typically accepts analog signals, a modulator is provided in the signal shaping unit to modulate the digital information over an analog signal carrier.

According to a further aspect in the magnetic card reader device, the said modulator is adapted to incorporate any modulation scheme including ASK, QPSK, MSK, MPSK, PSK etc preferably FSK modulation.

According to another aspect in the magnetic card reader device, the analog signal used for modulation is generated locally by using an oscillator comprising of simple analog components such as capacitor and inductor, or a frequency generator such as VCO or a digital microcontroller followed by a low pass filter.

According to yet another aspect in the magnetic card reader device, the device is adapted to transmit digital information serially without any modulation.

According to yet another aspect in the magnetic card reader device, the signal shaping unit involving encoder is adapted to employs an encoding scheme, preferably Manchester encoding, for encoding the digital data prior to transmission to prevent channel saturation.

According to a further aspect in the magnetic card reader device, the signal shaping unit additionally contains an amplifier and/or a band pass filter for setting the amplitude and bandwidth of the modulated or encoded signal.

According to a further aspect in the magnetic card reader device, the power unit preferably contains a battery or a socket to take power from an external source or means for extracting the energy for device functioning from the audio port of the companion device.

According to a further aspect in the magnetic card reader device, the means for extracting the energy from the companion device involves audio frequencies which are sent via the audio output line of the companion device to energy harvester circuit

comprising of a step-up transformer, a rectifier and filters to provide power to the magnetic card reader device.

According to yet another aspect in the magnetic card reader device, the means for converting digital bit stream into digital data and encrypting the data comprises microcontroller for the said operation.

According to another aspect in the present invention, the said device for data converting and encrypting additionally contain a dedicated encryption chip for data encryption purpose.

According to yet another aspect in the magnetic card reader device, the microcontroller is adapted to provide a temporary buffer for temporary storage of the data.

According to a further aspect in the magnetic card reader device, when conversion of the read head generated waveform into digital data is done by microcontroller; the detector unit is replaced with a signal setting unit for setting the waveform amplitude and offset.

In accordance with another aspect in the present invention there is provided a method of operation of the magnetic card reader comprising steps of

swapping of the magnetic stripe card through the slot having magnetic stripe read head;

generating a waveform by the said read head which is indicative of the data on the magnetic stripe;

processing the waveform to get the information on the magnetic stripe in digital form by using a decoder circuit or alternatively using a signal setting unit along with a microcontroller followed by executing an optional encryption operation by the microcontroller or by an independent encoder chip;

modulating the digital information over an analog signal carrier and transmitting the modulated digital information by a signal shaping unit to the companion device through its microphone input line;

demodulating the received signal in the companion device to get back the information in digital form and to perform a transaction.

In accordance with another aspect in the present invention there is provided another method of operation of the magnetic card reader device comprising steps of

swapping of the magnetic stripe card through the slot having magnetic stripe read head;

generating a waveform by the said read head which is indicative of the data on the magnetic stripe;

processing the waveform to get the information on the magnetic stripe in digital form by using a decoder circuit or alternatively using a signal setting unit along with a microcontroller followed by executing an optional encryption operation by the microcontroller or by an independent encoder chip

receiving the instructions from the companion device regarding to the requests for information from the card reader device;

acting of the microcontroller upon this instruction and processing the card data to extract the requested information in either encrypted or without encryption form;

modulating the digital information over an analog signal carrier and transmitting the modulated digital information by a signal shaping unit to the companion device through its microphone input line;

demodulating the received signal in the companion device to get back the information in digital form and to perform a transaction

In accordance with yet another aspect in the present invention there is provided a method of operation of the magnetic card reader device comprising steps of

swapping of the magnetic stripe card through the slot having magnetic stripe read head;

generating a waveform by the said read head which is indicative of the data on the magnetic stripe;

processing the waveform to get the information on the magnetic stripe in digital form by using a decoder circuit or alternatively using a signal setting unit along with a microcontroller followed by executing an optional encryption operation by the microcontroller or by an independent encoder chip;

transmitting the digital information serially into the companion device through its microphone input line as direct digital communication without any modulation, preferably after an encoding operation;

decoding or reconstructing the received signal in the companion device to get back the information in digital form and to perform a transaction;

In accordance with another aspect in the present invention there is provided an other method of card reading involving the magnetic card reader comprising steps of
swapping of the magnetic stripe card through the slot having magnetic stripe read head;
generating a waveform by the said read head which is indicative of the data on the magnetic stripe;
processing the waveform to get the information on the magnetic stripe in digital form by using a decoder circuit or alternatively using a signal setting unit along with a microcontroller followed by executing an optional encryption operation by the microcontroller or by an independent encoder chip
receiving the instructions from the companion device regarding to the requests for information from the card reader device;
acting of the microcontroller upon this instruction and processing the card data to extract the requested information in either encrypted or without encryption form;
transmitting the digital information serially into the companion device through its microphone input line as direct digital communication without any modulation, preferably after an encoding operation;
decoding or reconstructing the received signal in the companion device to get back the information in digital form and to perform a transaction

According to yet another aspect in the magnetic card reader device, the device is adapted to read one or multiple tracks and the read head generates separate waveforms corresponding to each of these tracks, correspondingly the decoder circuit generates separate digital bit streams for each of these tracks.

According to another important aspect in the present invention there is provided system for transaction and operation based on information stored on magnetic stripe comprising :

(I) A device reading information stored on magnetic stripe comprising
means to swipe or register a card having a magnetic stripe;

reading head adapted to generate a signal or waveform that is representative of the data encoded on the magnetic stripe;

decoding means adapted for converting the signal or waveform into a digital bit stream;

means for converting digital bit stream into digital data and optionally encrypting the converted digital data;

means adapted to establish operative communication link with a companion electronic device or media and to facilitate the transmission of the digital data;

a power unit adapted to provide power for the functioning of the magnetic card reader and

(II) companion electronic media or device adapted for receiving the signals representative of the data stored on magnetic stripe from said device for desired transaction and operation based on processed information.

According to yet another aspect in the system, the said means is adapted for establishing operative communication with the companion electronic device establishing unidirectional or bidirectional communication link between the reader device and the companion device.

In accordance with another aspect in the present system, the companion electronic media or device comprises: a signal shaping unit realised using hardware or software or both adapted to set amplitude and bandwidth of the received signals representative of the data stored on magnetic stripe card and a microcontroller having application software loaded into it for performing transactions and/or operations based upon the signals.

According to yet another aspect in the present system, the system is adapted to be used as a Point-of-sale device as it can be used in conjunction with a companion device such as mobile phone to read a credit card.

According to another aspect in the system, the companion device such as mobile phone having suitable application software loaded in it is adapted to use the card details for making a payment to make peer-to-peer money transfer.

BRIEF DESCRIPTION OF THE ACCOMPANYING FIGURES:

Figure 1 and 2 are the schematic illustration of two preferred embodiments of the present card reader device in accordance with the present invention showing the perspective view (a); side perspective view (b); side view (c); front view (d) of the said device.

Figure 3 is the schematic representation of another preferred embodiment of the said card reader device showing the perspective view (a) of the card reader device with a headset plug at the end of a flexible cable and perspective view (b) of the card reader device with audio and microphone plugs at the end of a bifurcating cable.

Figure 4 shows preferred system architectures of the presently disclosed card reader device according to the present invention.

Figure 5 is the schematic diagram of a preferred system architecture of the disclosed card reader device supporting bi-directional communication method.

Figure 6 is the schematic diagram of another possible architecture of the disclosed card reader device in accordance with the present invention.

Figure 7 is the schematic illustration of another possible architecture of the present card reader device supporting bi-directional communication method.

Figure 8 shows the electric diagram of the energy harvesting circuit of the present card reader device.

Fig. 9 shows schematic diagram of using a microcontroller as a Modem or as an Encoder-Decoder.

Fig. 10 is a flowchart of a method of operation and use of card reader device supporting only one-direction transfer of information constructed according to the present invention.

Fig. 11 is a flowchart of a method of operation and use of card reader device supporting bi-directional communication constructed according to the present disclosure.

Fig. 12 is a flowchart of another method of operation and use of card reader device supporting only one-direction transfer of information constructed according to the present disclosure.

Fig. 13 is a flowchart of another method of operation and use of card reader device supporting bi-directional communication constructed according to the present disclosure

DETAILED DESCRIPTION OF THE INVENTION IN ACCORDANCE WITH THE ACCOMPANYING FIGURES:

The present invention is directed to provide a card reader device for reading a card having data stored on a magnetic stripe and system for transaction and operation based on information stored on the magnetic stripe. More specifically, the present invention is directed to provide a card reading device which is adapted to be used in conjunction with other electronic device including mobile phone, computer, PDA etc. enabling unidirectional or bi directional communication link with the associate electronic devices even through their microphone input or audio lines. The present card reader device is further adapted to encrypt the data obtained from the magnetic stripe during the transmission.

Reference is first invited form the accompanying figure 1 which shows one of the illustrative embodiments of the magnetic card reader device according to the present invention. As shown in the figure, the magnetic card reader device **10** comprises of a housing **11** having a slot **12** and an output jack **13** extending out of the housing **11**. In this embodiment the slot **12** is placed parallel to the output jack **13** axis.

Reference is next invited from Figure 2 which shows yet another embodiment of the present magnetic card reader device. According to the said figure, the magnetic card reader device **14** comprises of a housing **15** having a slot **16** and an output jack **17** extending out of the housing. In this embodiment the slot **16** is placed perpendicular to the output jack **17** axis.

The output jack (**13** or **17**) of the card reader device is adapted to be inserted into the headset plug or into the microphone input plug of the companion device such as computer, mobile phone, PDA etc. The output jack may be a TRS (Tip, Ring, Sleeve) connector also known as audio jack, headset plug, phone plug, jack plug, stereo plug, mini jack or mini stereo connector. The said output jack may be formed of different sizes such as miniaturized versions that are 3.5 and 2.5 mm. It is also possible and contemplated that the jack may be retractable within the housing.

The slot **12** of the Fig 1 and slot **16** of Fig 2 is wide enough and deep enough to accept a card having a magnetic stripe. The slot also has a length that is less than the length of the card to be inserted into the slot. However, it is also possible and contemplated that the slot may have other lengths if desired for a given application. The housing may also be formed in different shapes and sizes.

Reference is next invited from the figure 3(a) which is schematic representation of another possible embodiment of the magnetic card reader device in accordance with the present invention. The magnetic card reader device **18** comprises of a housing **19** having a slot **20**, a cable **21** extending out of the housing **19** and a jack **22** at the other end of the cable **21**. The jack **22** is adapted to be inserted into the headset/audio/microphone port of the companion device such as computer, mobile phones, PDA etc. Such an embodiment allows one to place the magnetic card reader device at a location convenient to the user.

Fig 3(b) shows yet another embodiment of the magnetic card reader device. The magnetic card reader device **23** comprises of a housing **24** having a slot **25**, a cable **26** extending out of the housing **24**, terminating in two jacks **27** & **28**, adapted to be inserted into the microphone and audio ports of the companion device. This

embodiment will be particularly useful for devices which have separate ports for microphone and audio such as laptops.

Reference is further invited from the figure 4 which illustrates the schematic diagram of the system architectures of the magnetic card reader device. As shown in the accompanying figure, the magnetic card reader device **101** comprises of read head **103** such as inductive pick up head. Although not shown explicitly in the figure, the read head **103** is positioned along the slot **102** of magnetic card reader device **101**, so that when magnetic stripe of a magnetic stripe card is moved or passed through the slot **102**, the read head **103** can read the data stored on the magnetic stripe. The read head **103** produces a signal or waveform that is representative of the data encoded on the magnetic stripe. This waveform is sent to a decoder circuit for converting it into a digital bit stream that can be sent as input to the microcontroller **105**. The decoder circuit **104** may be a F2F decoder IC whose input is an F2F encoded waveform like the one generated by the read head **103** and output is a digital bit stream and a clock signal. The magnetic stripe on the magnetic card may contain data along one or more tracks. The read head **103** is adapted to read one or multiple tracks. The read head **103** generates separate waveforms corresponding to each of these tracks. Correspondingly the decoder circuit **104** generates separate digital bit streams for each of these tracks.

The output of the decoder IC is sent to the microcontroller **105** which processes the incoming digital bit stream and converts the data stored on the magnetic stripe into a digital data. The microcontroller **105** is adapted to perform additional tasks like encrypting the digital data before transmission. It should be noted that the data encryption can be done by a dedicated encryption chip (not shown in the diagram). The microcontroller **105** is further adapted to provide a temporary buffer for temporary storage of the data. The microcontroller then transmits the digital information to the companion device **109**. However, the input jack **110** of the companion device **109** typically expects analog signals. Because of this reason, the digital information to be transmitted is first passed through a signal shaping unit **106** before it is transmitted over the output jack **107**.

The signal shaping unit **106** preferably is a modulator resulting into a Modulated digital communication. The modulator modulates a locally generated analog signal

carrier to encode the digital information for transmission. FSK modulation is one of the preferred modulation schemes. However, any other modulation scheme such as ASK, QPSK, MSK, MPSK, PSK etc may also be used. The analog signal which is used for modulation is generated locally by an analog circuitry like an oscillator comprising of simple analog components such as capacitor and inductor, or a frequency generator such as VCO or a digital microcontroller followed by a low pass filter.

Alternatively, the data may be transmitted serially over the output jack without first modulating it. In that case, the signal shaping unit **106** is an encoder that employs an encoding scheme such as Manchester encoding scheme for encoding the data prior to transmission. Any other encoding scheme may also be used. It must be noted that encoding is not compulsory for serial transmission of data, but is recommended to prevent channel saturation. The signal shaping unit additionally contains an amplifier and/or a band pass filter for setting the amplitude and bandwidth of the modulated or encoded signal.

The output jack **107** is adapted to be inserted into the microphone input plug **110** of the companion device **109**. The companion device **109** may be a mobile phone, a computer, PDA or any other device having a microphone input line, provided either separately as microphone input port or as a headset port. The signal transmitted over the output jack **107** is send to the microphone input line of the companion device. A scheme, corresponding to the one implemented in the magnetic card reader device **101** is implemented in the signal shaping unit **111** of the companion device **109**. This signal shaping unit **111** is also adapted to set amplitude and bandwidth of the received signals. The signal shaping unit **111** may be realised using hardware or software or both. The signal representative of the data stored on magnetic stripe card is finally received by the microcontroller **112** which might contain application software loaded into it for performing transactions and/or operations based upon the card details.

The companion device **109** may also include components such as memory, including flash, ROM, SRAM, LCD driver, display, camera, battery, antenna, speaker, keypad etc for interacting with the user. For the sake of the clarity, most of the components of the companion device **109** have not been shown in the figure.

The power for the functioning of the magnetic card reader **101** is provided by the power unit **108**. It preferably contains a battery to supply power, or may contain a socket to take power from an external source. It might also be possible that the energy for device functioning is extracted from the audio port of the companion device **109**. In this method of extracting energy from the companion device, the companion device produces audio frequencies which are sent via the audio output line to the companion device. This audio signal is sent to energy harvester circuit comprising of a step-up transformer, a rectifier and filters. In this way, power is transferred to the magnetic card reader device **101** from the companion device **109**. Any of the left or right audio line may be used for sending audio signal to the energy harvester circuit. The accompanying Figure 8 shows diagram of such energy harvester circuit.

In case of stereo microphone input line, the signals containing information of data along different tracks of the magnetic card reader may be transmitted along different microphone input lines.

Figure 5 shows another embodiment of the magnetic card reader device. It defers from the magnetic card reader device **101** of Fig 4 in the sense that it allows bi-directional communication between the magnetic card reader device **201** and the companion device **209**. The output jack **207** of the magnetic card reader **201** is adapted to be inserted into the microphone and audio lines of the companion device. The microcontroller **205** receives instructions from the companion device to perform operations and sends data and information back to the companion device. The Signal shaping Unit **206** is a Modem (Modulator-Demodulator) or an Encoder-Decoder, with an amplifier and a band pass filter. The information to be transmitted to the companion device is modulated or encoded by signal shaping unit **206** and sent to the companion device **209** through its microphone input line. On the other hand, the information being transmitted from the companion device **209** is received from its audio output line and is demodulated or decoded inside the magnetic card reader **201** by the signal shaping unit **206**. The microcontroller **205** receives and sends digital signal to the Signal shaping unit **206**. A corresponding Signal shaping unit **211** (comprising of a Modem or an encoder-decoder) is implemented in the companion device as well. Rest of the organisation of the magnetic card reader **201** is same as of magnetic card reader **101**.

Accompanying figure 6 shows the schematics of another embodiment for the magnetic card reader device. The illustrative embodiment of the magnetic card reader device as shown in the said figure comprises of a read head **303** such as inductive pick up head. The read head is positioned along the slot **302** of the magnetic card reader device **301**, so that when magnetic stripe of a magnetic stripe card is moved or passed through the slot 302, the read head **303** can read the data stored on the magnetic stripe. The read head **303** produces a signal or waveform that is representative of the data encoded on the magnetic stripe. This waveform is passed through a signal setting unit **304** for setting its amplitude and offset. This signal is then given to a microcontroller **305** for conversion into a digital form. In this method of reading the magnetic card, a decoder circuit for converting the waveform into digital bit stream is not required. The microcontroller **305** is adapted to process the data (eg. encryption) besides providing a buffer for temporary storage. It should be noted that the data encryption can be done by a dedicated encryption chip (not shown in the diagram). The processed information to be transmitted is sent to a signal shaping unit **306** which is essentially a modulator or an encoder with an amplifier and a band pass filter, as explained in the above paragraphs. The output of the signal shaping unit **306** is a modulated or encoded signal suitable for transmission over the output jack **307**. The output jack **307** is adapted to be inserted into the microphone input line of the companion device. The schematic of the companion device for magnetic card reader **301** is same as the companion device **109** which has been explained before. In case of stereo microphone input line, the signals containing information of data along different tracks of the magnetic card reader may be transmitted along different microphone input lines.

The magnetic card reader device as disclosed in the figure 6 can be further modified to facilitate bi-directional communication and the schematics of such modified embodiment has shown in figure 7. According to the figure, the output jack **407** is adapted to be inserted into the microphone and audio lines of the companion device. The signal shaping unit **406** comprises of a Modem (modulator-demodulator) or an Encoder-Decoder, besides amplifier and band pass filer. The information to be transmitted to the companion device is modulated or encoded by signal shaping unit **406** and sent to the companion device **409** through its microphone input line. On

the other hand, the information being transmitted from the companion device **409** is received from its audio output line and is demodulated or decoded inside the magnetic card reader **401** by the signal shaping unit **406**. The microcontroller **405** receives and sends digital signal to the Signal shaping unit **406**. Companion device **409** is same as the companion device **209** of Fig 5.

Fig 9 shows a preferred approach where hardware features such as Timer and UART of microcontroller are used to efficiently modulate and demodulate FSK signals. On the modulator side, data bits generated by UART transmitter **47** are fed back into microprocessor **44** interrupt line. A timer compare unit **45** generates the correct frequency (Tone Encoder **46**) according to the incoming bit from UART transmitter **47**. The output of timer compare unit **45** is passed through a low pass filter **52** before sending to the output jack of magnetic card reader device. On the demodulator side, the signal received from the output jack of magnetic card reader device is AC coupled to a voltage divider **48** whose mid-point is set to a specific value. Zero crossing time of the signal is achieved by comparing the signal to this specific value in comparator **49**. In software, the time difference between rising and falling edges is calculated by edge time measurement unit **50** using timer. The result of this is then sent to receiver port of UART peripheral **53**. Another preferred manner in which FSK modulation scheme can be implemented is pure software based approach in which FSK libraries are used on the microcontroller. Similarly, the Encoder of the signal shaping unit may also be implemented on the microcontroller itself.

Fig 10 shows a flowchart describing the method of operation of the magnetic card reader device 101. More specifically, the method as disclosed in this figure is directed to explain operation of the magnetic card reader device having unidirectional communication link with the companion device and a signal shaping unit adapted to modulate the information over an analog carrier. The method 70 begins in operation 71 in which the magnetic stripe of the magnetic stripe card is through the slot 102 by the read head 103. The read head 103 in turn generates a waveform indicative of the data on the magnetic stripe (step 72). In the next step 73, the waveform is processed to get the information on the magnetic stripe in digital form. This may be done using a decoder circuit 104 (or alternatively using a signal setting unit 304 like the one shown in Fig 6) along with a microcontroller 105. The microcontroller 105

may then process the card digital data (may include encryption operation as well) and prepare the data for transmission, as shown in the step 74. The digital information to be transmitted is modulated over an analog signal carrier by a signal shaping unit 106 and sent into the companion device through its microphone input line to the companion device 109 (step 75). Once inside the companion device 109, the received signal is demodulated to get back the information in digital form (step 76) which is then used by the companion device to perform a transaction (step 77).

Fig 11 shows a variation of above method of operation of the magnetic card reader device 201 that supports bi-directional communication. The method 60 begins in operation 61 in which the magnetic stripe of the magnetic stripe card is through the slot 202 by the read head 203. The read head 203 in turn generates a waveform indicative of the data on the magnetic stripe (step 62). In the next step 63, the waveform is processed to get the information on the magnetic stripe in digital form. This may be done using a decoder circuit 204 (or alternatively using a signal setting unit 404 like the one shown in Fig 7) along with a microcontroller 205. In the next step 64, the companion device 209 requests information from the card reader device 201 by sending instruction as a modulated signal from its audio output line. The microcontroller 205 acts upon this instruction and processes the card data to extract the requested information (step 65). In step 66, the requested information (either encrypted or without encryption) is modulated over an analog signal carrier by a signal shaping unit 206 and sent into the companion device 209 through its microphone input line. Once inside the companion device 209, the received signal is demodulated to get back the information in digital form (step 67) which is then used by the companion device to perform a transaction (step 68).

Fig 12 shows a flowchart describing yet another method of operation of the magnetic card reader device having a unidirectional communication link with the companion device through which digital information is sent serially without any modulation. The method 80 begins in operation 81 in which the magnetic stripe of the magnetic stripe card is through the slot 102 by the read head 103. The read head 103 in turn generates a waveform indicative of the data on the magnetic stripe (step 82). In the next step 83, the waveform is processed to get the information on the magnetic stripe in digital form. This may be done using a decoder circuit 104 (or alternatively using a signal setting unit 304 like the one shown in Fig 6) along with a

microcontroller 105. The microcontroller 105 may then process the card digital data (may include encryption operation as well) and prepare the data for transmission, as shown in the step 84. The digital information to be transmitted is sent serially into the companion device 109 through its microphone input line (step 85) as direct digital communication without any modulation. The digital information may be encoded using an encoding scheme such as Manchester encoding implemented in signal shaping block 106 to prevent channel saturation. Once inside the companion device 109, the received signal is decoded or reconstructed to get back the information in digital form (step 86) which is then used by the companion device to perform a transaction (step 87).

Fig 13 shows a variation of above method of operation of the magnetic card reader device 201 that supports bi-directional communication. The method 90 begins in operation 91 in which the magnetic stripe of the magnetic stripe card is through the slot 202 by the read head 203. The read head 203 in turn generates a waveform indicative of the data on the magnetic stripe (step 92). In the next step 93, the waveform is processed to get the information on the magnetic stripe in digital form. This may be done using a decoder circuit 204 (or alternatively using a signal setting unit 404 like the one shown in Fig 7) along with a microcontroller 205. In the next step 94, the companion device 209 requests information from the card reader device 201 by sending instruction as a modulated signal from its audio output line. The microcontroller 205 acts upon this instruction and processes the card data to extract the requested information (step 95). In step 96, the requested information (either encrypted or without encryption) is sent serially (optionally encoded by an encoding scheme such as Manchester Encoding) without any modulation into the companion device 209 through its microphone input line. Once inside the companion device 209, the received signal is demodulated to get back the information in digital form (step 97) which is then used by the companion device to perform a transaction (step 98).

The magnetic card reader device may contain some driver ICs, power management unit and additional circuitry for noise removal, buffering, voltage equalization etc. for proper functioning and integrator of various units described in the above schematics. The schematics shown in above figures are just for the clarity of the architecture. A person skilled in the art can however combine, add, remove or substitute some of these while still attaining the same functionality. For example, the encryption might

be performed using a dedicated hardware accelerator such as an encryption engine. Another example is where the microcontroller and the signal shaping unit are combined together and realised using a single microcontroller by making use of its software and hardware peripherals.

The disclosed magnetic card reader device can be constructed in various shapes and sizes, and is not limited only to the shapes shown in present disclosure. The slot for swiping the magnetic stripe of the magnetic stripe card may be along any surface of the device housing. It may be understood that any known one or more common protocols may be employed for communication between various blocks shown in the schematics.

The disclosed magnetic card reader device can be used to perform transactions based on data on magnetic stripe card. The magnetic card reader device may be used as a Point-of-sale device. It can be used in conjunction with a companion device such as mobile phone to read a credit card. Application software loaded into the companion device can then use these card details for making a payment. Since the disclosed magnetic card reader can be used even with mobile phones, it can be used to make peer-to-peer money transfer.

We claim:

1. A magnetic card reader device for reading information stored on magnetic stripe card comprising
   means to swipe or register a card having a magnetic stripe;

   reading head adapted to generate a signal or waveform that is representative of the data encoded on the magnetic stripe;

   decoding means adapted for converting the signal or waveform into a digital bit stream;

   means for converting digital bit stream into digital data and optionally encrypting the converted digital data;

   means adapted to establish operative communication link with a companion electronic device and to facilitate the transmission of the digital data;

   a power unit adapted to provide power for the functioning of the magnetic card reader.

2. A device as claimed in claim 1 wherein said means adapted for establishing operative communication with the companion electronic device like mobile phone, computer, laptop, PDA etc comprise an output jack adapted to be inserted into a microphone or audio input plug input line of a companion electronic device

3. A magnetic card reader device as claimed in anyone of the claim 1 or 2 wherein said means adapted for establishing operative communication involves a signal setting unit adapted to setup unidirectional or bidirectional communication link between the reader device and the companion device comprising.

4. A magnetic card reader device as claimed in anyone of the claim 1 to 3 wherein the input plug of the companion device typically accepts analog signals, a modulator is provided in the signal shaping unit to modulate the digital information over an analog signal carrier.

5. A magnetic card reader device as claimed in claim 4 adapted for any modulation scheme including ASK, QPSK, MSK, MPSK, PSK etc preferably FSK modulation.

6. A magnetic card reader device as claimed in claim 5 wherein, the analog signal used for modulation is generated locally by using an oscillator comprising of simple analog components such as capacitor and inductor, or a frequency generator such as VCO or a digital microcontroller followed by a low pass filter.

7. A magnetic card reader device as claimed in anyone of the claim 1 to 6 wherein the said reader device is adapted to transmit digital information serially without any modulation.

8. A magnetic card reader device as claimed in claim 7 wherein the said signal shaping unit involving encoder is adapted to employs an encoding scheme, preferably Manchester encoding, for encoding the digital data prior to transmission to prevent channel saturation.

9. A magnetic card reader device as claimed in anyone of the claim 1 to 8 wherein, the signal shaping unit additionally contain an amplifier and/or a band pass filter for setting the amplitude and bandwidth of the modulated or encoded signal.

10. A magnetic card reader device as claimed in anyone of the claim 1 to 9 wherein the power unit preferably contains a battery or a socket to take power from an external source or means for extracting the energy for device functioning from the audio port of the companion device.

11. A magnetic card reader device as claimed in claim 10 wherein said means for extracting the energy from the companion device involves audio frequencies which are sent via the audio output line of the companion device to energy harvester circuit comprising of a step-up transformer, a rectifier and filters to provide power to the magnetic card reader device.

12. A magnetic card reader device as claimed in anyone of the claim 1 to 11, wherein the means for converting digital bit stream into digital data and encrypting the data comprises microcontroller for the said operation.

13. According to claim 12 wherein the data converting and encrypting additionally contain a dedicated encryption chip for data encryption purpose.

14. A magnetic card reader device as claimed in anyone of the claim 1 to 13 wherein the microcontroller is adapted to provide a temporary buffer for temporary storage of the data.

15. A magnetic card reader device as claimed in anyone of the claim 1 to 14 wherein conversion of the read head generated waveform into digital data is done by microcontroller; the detector unit is replaced with a signal setting unit for setting the waveform amplitude and offset and encryption is done by the microcontroller itself or by the dedicated encryption chip.

16. A method of operation of the magnetic card reader device as claimed in anyone of claim 1 to 15 comprising steps of

swiping of the magnetic stripe card through the slot having magnetic stripe read head;

generating a waveform by the said read head which is indicative of the data on the magnetic stripe;

processing the waveform to get the information on the magnetic stripe in digital form by using a decoder circuit or alternatively using a signal setting unit along with a microcontroller followed by executing an optional encryption operation by the microcontroller or employing a dedicated encryption chip;

modulating the digital information over an analog signal carrier and transmitting the modulated digital information by a signal shaping unit to the companion device through its microphone input line;

demodulating the received signal in the companion device to get back the information in digital form and to perform a transaction.

17. A method of operation of the magnetic card reader device as claimed in anyone of claim 1 to 15 comprising steps of

swiping of the magnetic stripe card through the slot having magnetic stripe read head;

generating a waveform by the said read head which is indicative of the data on the magnetic stripe;

processing the waveform to get the information on the magnetic stripe in digital form by using a decoder circuit or alternatively using a signal setting unit along with a microcontroller;

optionally encrypting the digital data either using the same microcontroller or employing a dedicated encryption chip

receiving the instructions from the companion device regarding to the requests for information from the card reader device;

acting of the microcontroller upon this instruction and processing the card data to extract the requested information in either encrypted or without encryption form;

modulating the digital information over an analog signal carrier and transmitting the modulated digital information by a signal shaping unit to the companion device through its microphone input line;

demodulating the received signal in the companion device to get back the information in digital form and to perform a transaction

18. A method of operation of the magnetic card reader device as claimed in anyone of claim 1 to 15 comprising steps of

swiping of the magnetic stripe card through the slot having magnetic stripe read head;

generating a waveform by the said read head which is indicative of the data on the magnetic stripe;

processing the waveform to get the information on the magnetic stripe in digital form by using a decoder circuit or alternatively using a signal setting unit along with a microcontroller followed by executing an optional encryption operation by the microcontroller or a dedicated encryption chip;
transmitting the digital information serially into the companion device through its microphone input line as direct digital communication without any modulation, preferably after an encoding operation;
decoding or reconstructing the received signal in the companion device to get back the information in digital form and to perform a transaction;

19. A method of operation of the magnetic card reader device as claimed in anyone of claim 1 to 15 comprising steps of:

swiping of the magnetic stripe card through the slot having magnetic stripe read head;

generating a waveform by the said read head which is indicative of the data on the magnetic stripe;

processing the waveform to get the information on the magnetic stripe in digital form by using a decoder circuit or alternatively using a signal setting unit along with a microcontroller;
optionally encrypting the digital data either using the same microcontroller or employing a dedicated encryption chip

receiving the instructions from the companion device regarding to the requests for information from the card reader device;

acting of the microcontroller upon this instruction and processing the card data to extract the requested information in either encrypted or without encryption form;

transmitting the digital information serially into the companion device through its microphone input line as direct digital communication without any modulation, preferably after an encoding operation;

decoding or reconstructing the received signal in the companion device to get back the information in digital form and to perform a transaction

20. A magnetic card reader device as claimed in anyone of the claim 1 to 19 wherein the device is adapted to read one or multiple tracks and the read head generates separate waveforms corresponding to each of these tracks, correspondingly the decoder circuit generates separate digital bit streams for each of these tracks.

21. A system for transaction and operation based on information stored on magnetic stripe comprising :

(I) A device for reading information stored on magnetic stripe comprising

means to swipe or register a card having a magnetic stripe;

reading head adapted to generate a signal or waveform that is representative of the data encoded on the magnetic stripe;

decoding means adapted for converting the signal or waveform into a digital bit stream;

means for converting digital bit stream into digital data and optionally encrypting the converted digital data;

means adapted to establish operative communication link with a companion electronic device or media and to facilitate the transmission of the digital data;

a power unit adapted to provide power for the functioning of the magnetic card reader and

(II) companion electronic media or device adapted for receiving the signals representative of the data stored on magnetic stripe from said device for desired transaction and operation based on processed information.

22. A device as claimed in claim 21 wherein said means adapted for establishing operative communication with the companion electronic device establish unidirectional or bidirectional communication link between the reader device and the companion device.

23. A system as claimed in anyone of claim 21 or 22 wherein the companion electronic media or device comprises:
    a signal shaping unit realised using hardware or software or both adapted to set amplitude and bandwidth of the received signals representative of the data stored on magnetic stripe card;

    microcontroller adapted for performing transactions and/or operations based upon the signals.

24. A system as claimed in anyone of claim 21 to 23 wherein the system is adapted to be used as a Point-of-sale device as it can be used in conjunction with a companion device such as mobile phone to read a credit card.

25. A system according to claim 24 wherein the companion device such as mobile phone having suitable application software loaded in it adapted to use the card details for making a payment to make peer-to-peer money transfer.

Dated this 3rd Day of December, 2012

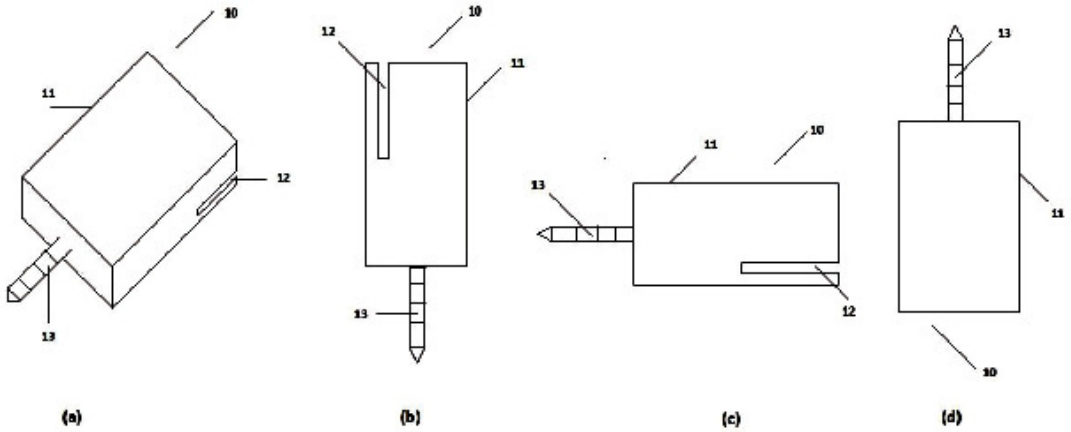
Gupta, Nalin

Gupta, Shailesh

ABSTRACT

Title: A CARD READER DEVICE AND METHOD OF USE

A card reader device for reading a card having data stored on a magnetic stripe incorporated into the card is disclosed where the card reader device is to be used in conjunction with a companion electronic device such as mobile phone, computer, PDA etc. The card reader device senses the data stored on a magnetic stripe by a read head, converts the signal indicative of the data stored on magnetic stripe into digital form, processes the digital data and sends the useful required information to a companion device (with or without encryption) for further use via an output jack adapted to be inserted into the microphone input of the companion device. Bi-directional communication with the companion device is also disclosed where the companion device sends signal containing information to the card reader from its audio output line.
(Figure 1)



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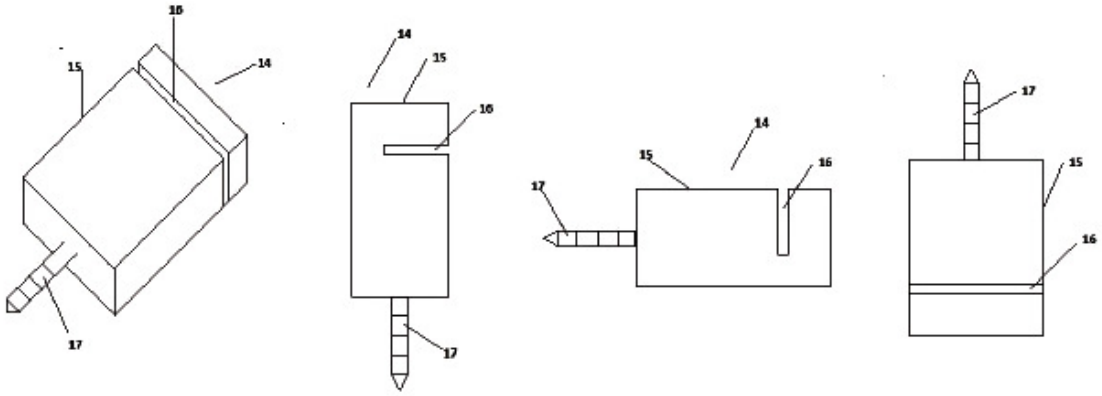

Fig. 2

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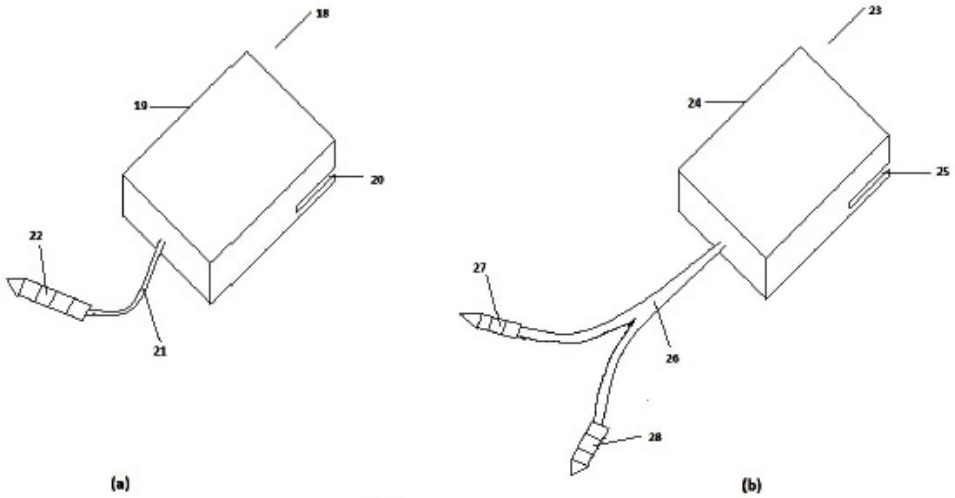

Fig 3

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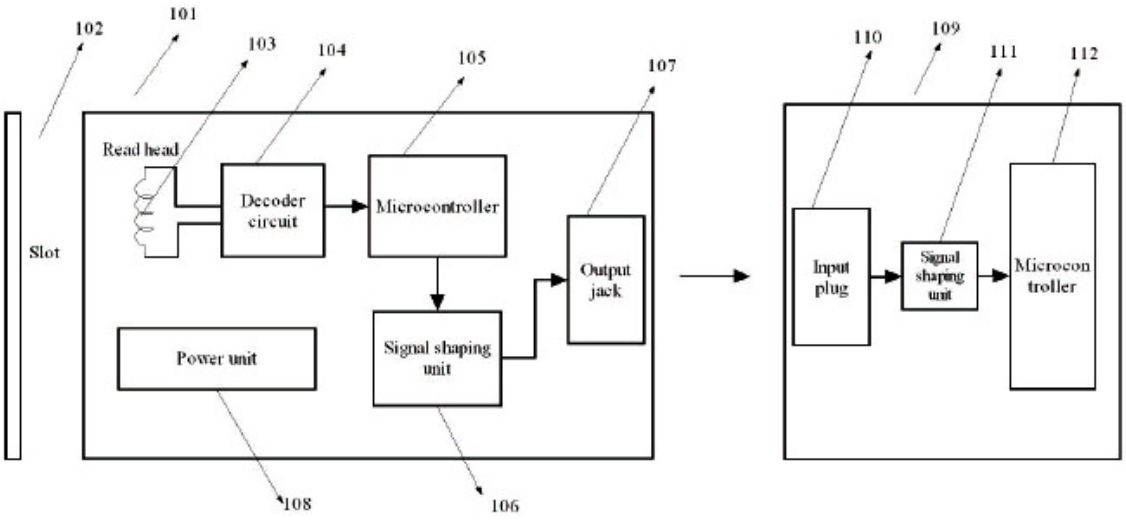

Fig. 4

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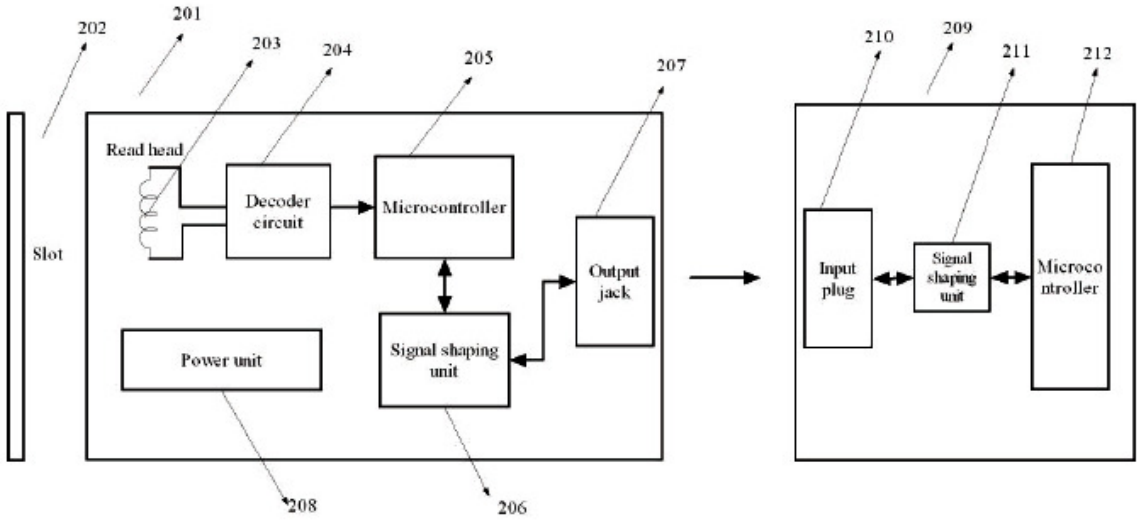

Fig. 5

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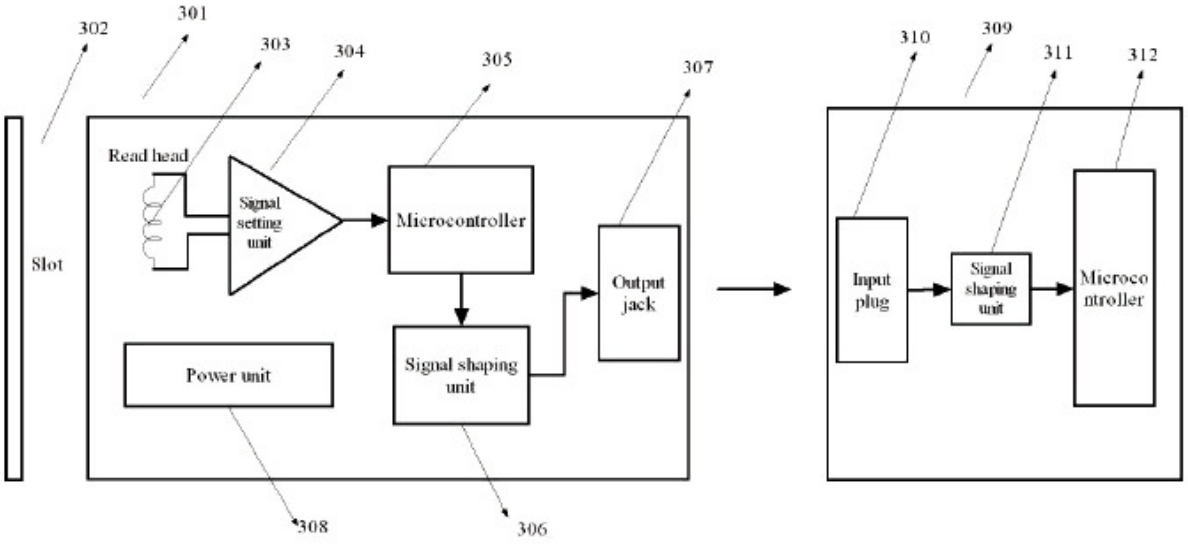

Fig. 6

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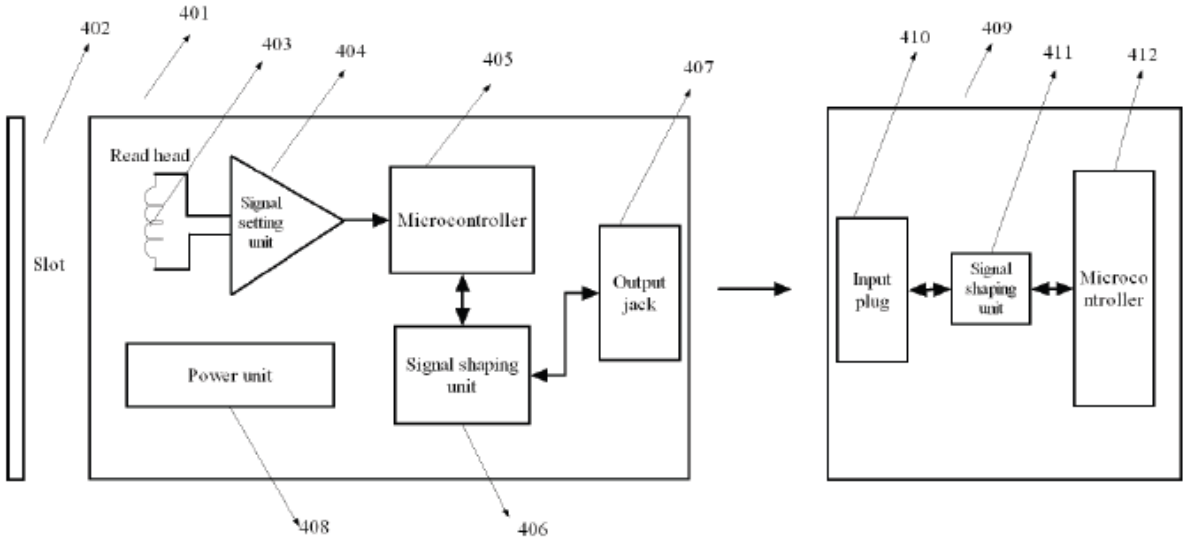

Fig. 7

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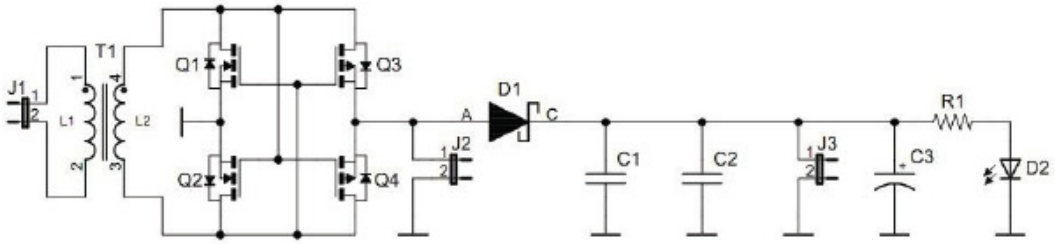

Fig. 8

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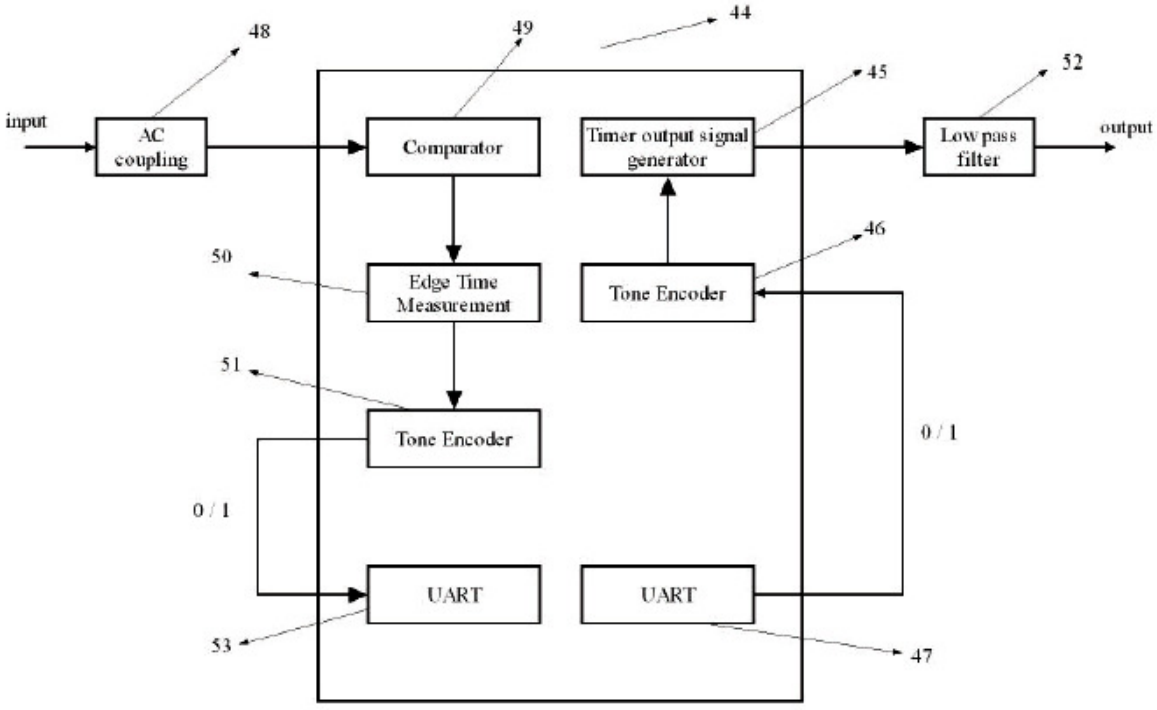

Fig. 9

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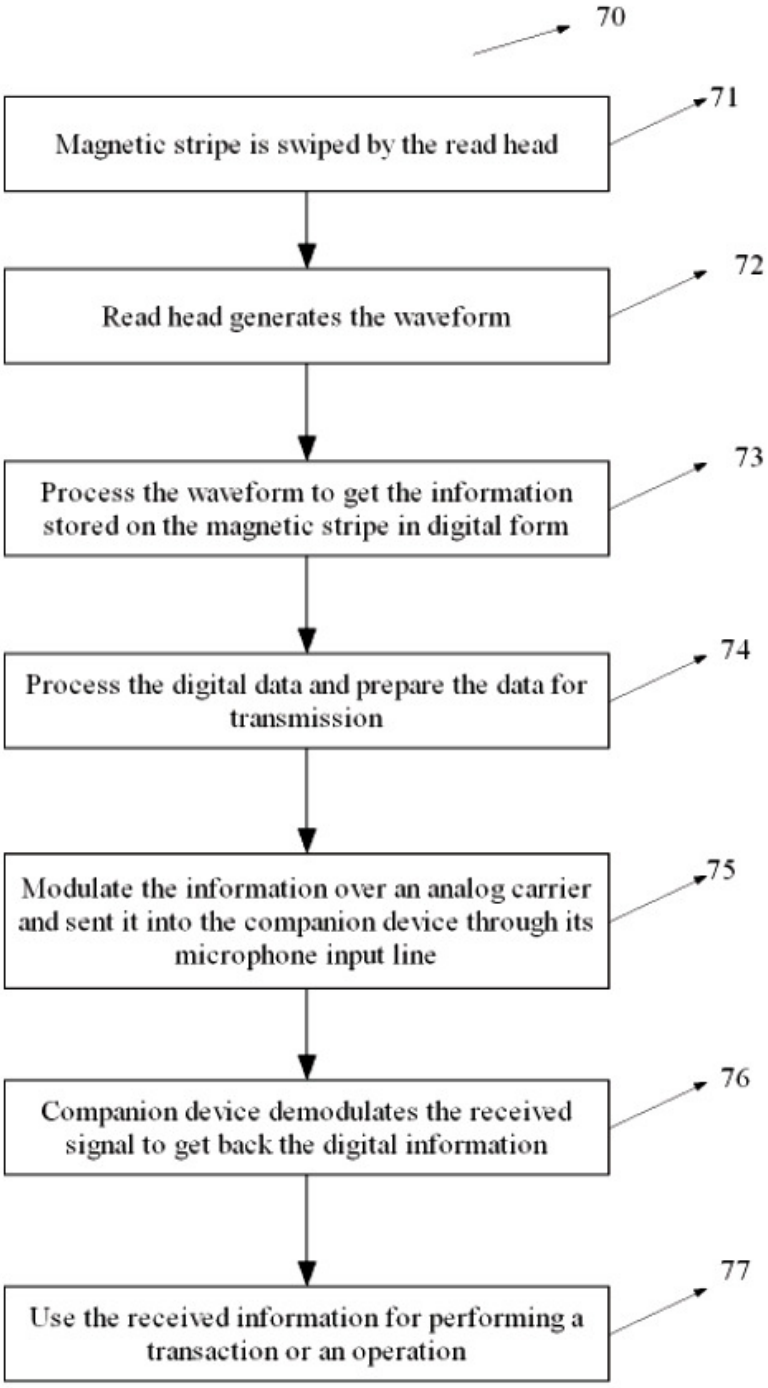

Fig. 10

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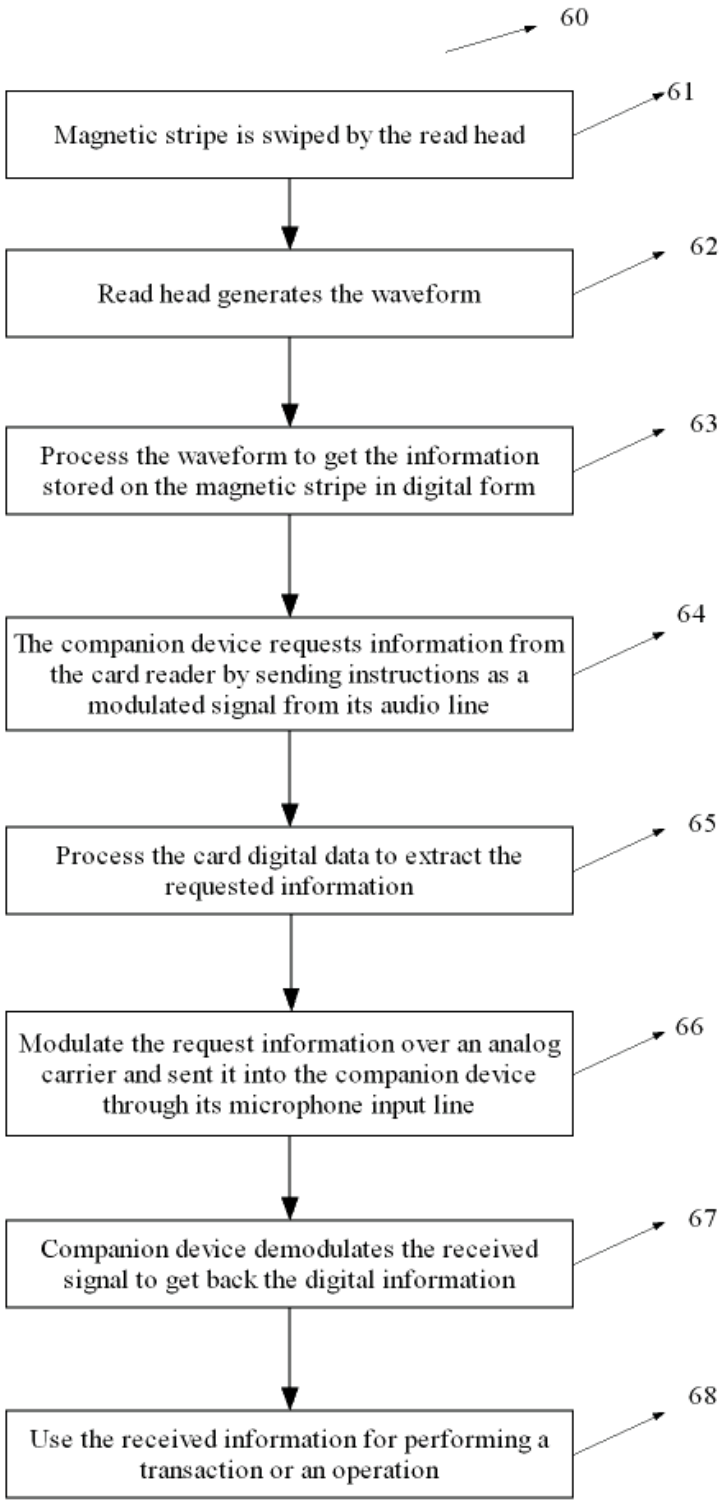

Fig. 11

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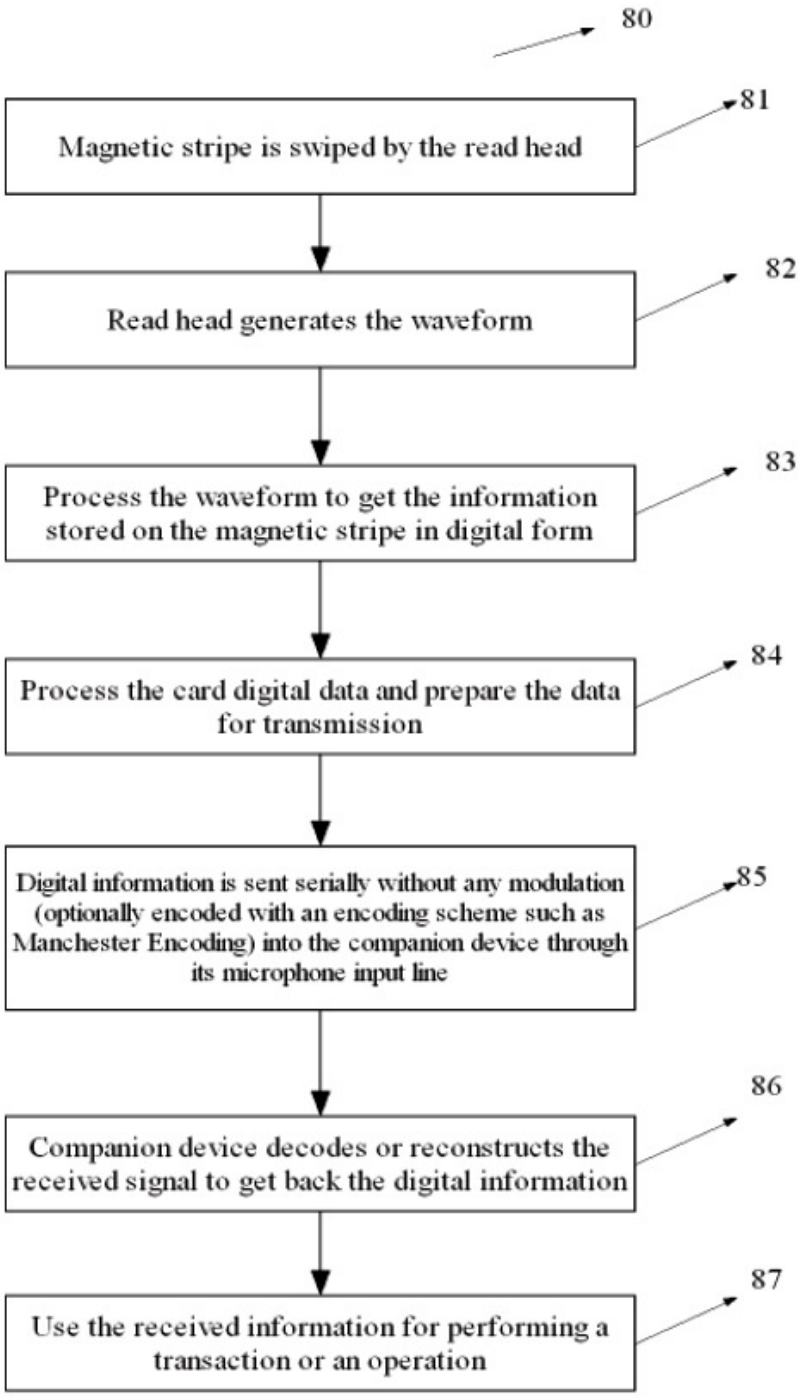

Fig. 12

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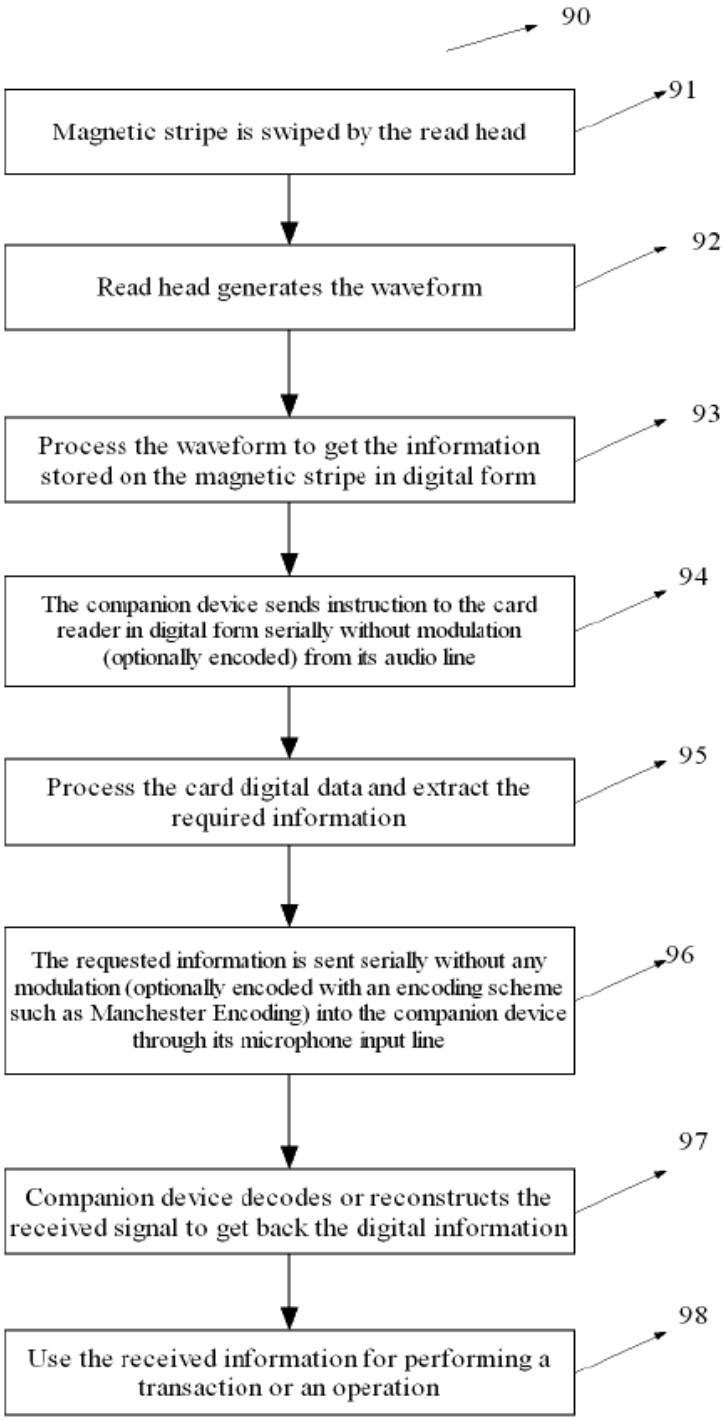

Fig. 13

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FORM 5

THE PATENTS ACT,1970
(39 of 1970)
&
THE PATENTS RULES,2003

DECLARATION AS TO INVENTORSHIP

[See Section 10(6) and rule 13(6)]

1. We, **GUPTA, Nalin**; An Indian Citizen; B-111, RK Hall of Residence, IIT Kharagpur, Kharagpur-721302, West Bengal, India; **GUPTA, Shailesh;** An Indian Citizen;C-109, Azad Hall of Residence, IIT Kharagpur, Kharagpur-721302, West Bengal, India

hereby declare that the true and first inventors of the invention disclosed in the complete specification filed in pursuance of our application numbered 1522/KOL/2011 dated 03.12.2011 are

2. INVENTOR(S)

1. (a) Name : **GUPTA, NALIN;**
   (b) Nationality : An Indian Citizen;
   (c) Address : B-111, RK Hall of Residence, IIT Kharagpur, Kharagpur-721302, West

2. (a) Name : **GUPTA, SHAILESH;**
   (b) Nationality : An Indian Citizen;
   (c) Address : C-109, Azad Hall of Residence, IIT Kharagpur, Kharagpur-721302, West

Dated this 3rd day of December, 2012

Signature

Name of the signatory **NALIN GUPTA**

Name of the signatory **SHAILESH GUPTA**

~~**3. DECLARATION TO BE GIVEN WHEN THE APPLICATION IN INDIA IS FILED BY THE APPLICANT(S) IN THE CONVENTION COUNTRY:**~~

~~We the applicant(s) in the convention country hereby declare that our right to apply for a patent in India is by way or assignment from the true and first inventor(s).~~

~~Dated this day of 2009~~

~~Signature~~

~~Name of the signatory~~

~~**4. STATEMENT** (to be signed by the additional inventor(s) not mentioned in the application form)~~

~~I/We assent to the invention referred to in the above declaration, being included in the complete specification filed in pursuance of the stated application.~~

To,
The Contoller of Patent
The Patent Office
Kolkata