consumer mobile device and wallet application for capturing magnetic stripe card data, storing the data securely, and transmitting such data to merchants' point of sale (POS) or checkout systems, in the physical and virtual environments.

[0005] The Magnetic Secure Transmission (MST) technique magnetically couples simulated magnetic stripe data into a POS magnetic stripe reader (MSR) **101** from a distance of 30 to 40 mm. An alternating polarity magnetic field **102** is generated by driving alternating polarity current through a suitably designed inductor. The MSR head, which contains an inductor, picks up the magnetic pulses and converts them to voltage pulses, which in turn are decoded by the reader circuit and terminal logic. This is schematically shown in **FIG. 1.**

However, in real life, inductors, including NFC inductors, do not have isotropic fields. Flat inductors, for example, tend to have doughnut shaped fields. Other inductors generate different field shapes.

The overlapping field patterns of the MST transmitter inductor and the reader head inductor result in one or more nulls: narrow areas where no signal transfer takes place. Depending on the inductor topology, these nulls can be either on the center-line of the reader head, or along the edges off to the sides. Nulls affect the reliability of card data transmissions. While users quickly learn in which position their LoopPay device works best, some inconvenience and the need for two or three tries results at times. When MST is integrated into a smart-phone, which is larger than a LoopPay device, precise placement is less likely and therefore first-time MST transmission success rate suffers.

SUMMARY OF INVENTION

In some examples, there is provided a transmitter to generate a signal to be read by a reader, comprising: a driver circuit; and at least two inductors connected to the driver circuit; wherein the driver circuit controls the current flow through the inductor that results in a signal; wherein each inductor has at least one null region, wherein the signal strength is below the detection limit of the reader; and wherein the inductors are positioned such that the null regions of the inductors do not overlap.

According to a first aspect of the present invention, there is provided a transmitter to generate a signal to be read by a reader, comprising: a driver circuit; and at least two inductors connected to the driver circuit; wherein the driver circuit controls a flow of current through the at least two inductors that results in a signal; wherein, along an axis while the current flows through, each inductor has two effective areas where a signal strength is greater than a detection limit of the reader and a null region there between where the signal strength is below the detection limit

of the reader; and wherein the inductors are positioned such that, along the axis: the null regions of the at least two inductors do not overlap, and the effective areas overlap along the axis, a total contiguous area of the signal along the axis having the signal strength being greater than any one of the effective areas and greater than the detection limit.

In some examples, there is provided a transmitter to generate a signal to be read by a reader, comprising: a driver circuit; and an inductor connected to the driver circuit; wherein the driver circuit controls the current flow through the inductor that results in a signal transmission; and wherein the driver circuit passes the current through the inductor multiple times while the inductor is moved relative to the reader head passing through a number of positions; and wherein at least one of the number of positions the inductor passes through the inductor produces a transmission signal that is greater than the reader threshold for a good data read.

In some examples, there is provided a method of driving the transmitter in accordance with the first aspect, wherein the method comprises flowing current through only one inductor at a given time.

In some examples, there is provided a method of driving a transmitter that includes a driver circuit and at least two inductors connected to the driver circuit with each inductor having at least one null region with a signal strength below the detection limit of a signal reader, wherein the driver circuit controls the current flow through the inductor that results in a signal, said method comprising the steps of: positioning the at least two inductors in the transmitter so that the null regions of the inductors do not overlap; and flowing current through the at least two inductors to generate a composite signal.

According to a second aspect of the present invention, there is provided a method of transmitting a signal to a signal reader, the method comprising the steps of: providing a transmitter configured to transmit the signal to the signal reader, the transmitter comprising a driver circuit and at least two inductors connected to a driver circuit, wherein each inductor of the at least two inductors has, when driven, two effective areas along an axis where a signal strength is greater than that of a null region between the effective areas, and wherein the null regions of the at least two inductors do not overlap; positioning the at least two inductors of the transmitter near the signal reader; and flowing current, by the driver circuit, through the at least two inductors to generate a composite signal, wherein while the current flows through while positioned near the transmitter, each of the effective areas has a signal strength that is greater than a detection limit of the signal reader and each of the nulls has a signal strength that is below the detection limit, and the effective areas overlap along the axis to form the composite signal, a total

contiguous area of the composite signal along the axis having the signal strength being greater than any one of the effective areas and greater than the detection limit.

In some examples, there is provided a method to generate a signal to be read by a reader by a transmitter including a driver circuit and an inductor connected to the driver circuit, said method comprising the steps of: flowing a current through the inductor multiple times to produce repeated signals for transmission; moving the inductor relative to the reader head passing through a number of positions while the current is being passed through he inductor; wherein at least one of the number of positions the inductor passes through, the inductor produces a transmission signal that is greater than the reader threshold for a good data read.

In some embodiments, a transmitter to generate a signal to be read by a reader is described. The transmitter includes a driver circuit; and at least two inductors connected to the driver circuit. The driver circuit controls the current flow through the inductor and the current flow results in a signal such that the signal strength is above the detection limit of the reader for each of the inductors which may have at least one null region. Additionally, the inductors are positioned such that the null regions of the inductors do not overlap.

In some embodiments, the inductors are positioned to produce regions where the signal strength is greater than the detection limit of the reader to result in good data read.

In some embodiments, the transmitter has only two inductors.

In some embodiments, the transmitter has at least one inductor that is an L-mode inductor and in other embodiments, the transmitter has at least one inductor that is an X-mode inductor.

What is claimed:

1. A transmitter to generate a signal to be read by a reader, comprising:

a driver circuit; and

at least two inductors connected to the driver circuit;

wherein the driver circuit controls a flow of current through the at least two inductors that results in a signal;

wherein, along an axis while the current flows through, each inductor has two effective areas where a signal strength is greater than a detection limit of the reader and a null region there between where the signal strength is below the detection limit of the reader; and

wherein the inductors are positioned such that, along the axis:

the null regions of the at least two inductors do not overlap, and

the effective areas overlap along the axis, a total contiguous area of the signal along the axis having the signal strength being greater than any one of the effective areas and greater than the detection limit.

2. The transmitter of claim 1, wherein the at least two inductors are only two inductors.

3. The transmitter of claim 1, wherein at least one inductor of the at least two inductors is an L-mode inductor.

4. The transmitter of claim 1, wherein at least one inductor of the at least two inductors is an X-mode inductor.

5. The transmitter of claim 1, wherein an inductor of the at least two inductors comprises a conductive material selected from a group consisting of a metal wire, a printed circuit board, and stamped sheet metal shapes.

6. The transmitter of claim 1, wherein an inductor of the at least two inductors comprises a plated conductive material.

7. The transmitter of claim 1, wherein an inductor of the at least two inductors comprises a conductive material coated with a material selected from a group consisting of enamel, acrylic or plastic.

8. The transmitter of claim 1, wherein each inductor of the at least two inductors comprises a conductive material shaped in a form selected from the group consisting of irregular, circle, polygon, rectangle, square, and triangle.

9. The transmitter of claim 4, wherein the X-mode inductor comprises a core.

10. The transmitter of claim 9, wherein the core is made of ferrite.

11. The transmitter of claim 9, wherein the core has a cross-sectional shape selected from the group consisting of irregular, circle, polygon, rectangle, square, and triangle.

12. The transmitter of claim 1, wherein a first inductor of the at least two inductors is an L-mode inductor and a second inductor of the at least two inductors is an X-mode inductor.

13. The transmitter of claim 1, wherein each inductor of the at least two inductors is an L-mode inductor.

14. The transmitter of claim 1, wherein each inductor of the at least two inductors is an X-mode inductor.

15. The transmitter of claim 1, wherein the driver circuit flows the current through the at least two inductors at the same time.

16. The transmitter of claim 1, wherein the driver circuit flows the current through the at least two inductors at the separate times.

17. A method of transmitting a signal to a signal reader

, the method comprising the steps of:

providing a transmitter configured to transmit the signal to the signal reader, the transmitter comprising a driver circuit and at least two inductors connected to a driver circuit, wherein each inductor of the at least two inductors has, when driven, two effective areas along an axis where a signal strength is greater than that of a null region between the effective areas, and wherein the null regions of the at least two inductors do not overlap;

positioning the at least two inductors of the transmitter near the signal reader; and

flowing current, by the driver circuit, through the at least two inductors to generate a composite signal,

wherein while the current flows through while positioned near the transmitter, each of the effective areas has a signal strength that is greater than a detection limit of the signal reader and each of the nulls has a signal strength that is below the detection limit, and

the effective areas overlap along the axis to form the composite signal, a total contiguous area of the composite signal along the axis having the signal strength being greater than any one of the effective areas and greater than the detection limit.

18. The method of claim 17, wherein the composite signal has a signal strength skewed towards one side of the signal reader.

19. The method of claim 17, wherein the step of flowing current through the at least two inductors comprises alternating between flowing current through the at least two inductors at a first time and flowing current through only one of the at least two inductors at a second time.

20. The method of claim 17, wherein the step of flowing current through the at least two inductors comprises having the current flow in a same direction through all of the inductors of the at least two inductors.

21. The method of claim 17, wherein the step of flowing current

through the at least two inductors comprises having the current flow through a first inductor of the at least two inductors in an opposite direction as compared with a second inductor of that at least two inductors.