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(54) Benævnelse: **METODE OG SYSTEM TIL IMPLEMENTERING AF KOMMUNIKATION VIA SYNLIGT LYS, SENDEAPPARAT OG MODTAGEAPPARAT**

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WO-A1-2010/103451
WO-A1-2012/003856
CN-A- 102 656 826
CN-A- 102 684 819
US-A1- 2009 284 366
US-A1- 2010 322 635

DESCRIPTION

Technical Field

[0001] The present invention relates to the visible light communication technology, and particularly, to a method and system for implementing visible light communication, a sending apparatus and a receiving apparatus.

Background of the Related Art

[0002] The wireless communication technology using the visible light has attracted attention from the academic circles and industrial circles in recent years. In particular, while the lighting equipment using light-emitting elements such as a light emitting diode (LED) and so on is widely used, the feasibility research on using a semiconductor LED to implement the visible light communication covered by the wireless communication network is ongoing. The appropriate approach of combining the visible light communication with a wireless sensor network, a wireless local area network (WLAN) and a power-line communication system is also in the discussion. It has been able to prove that such communication mode will be one of the alternative short-distance and ultra-wideband communication modes in the future.

[0003] As the light-emitting components used for the high-speed optical data communication, the influence on the human body or medical apparatus should be considered, and the LED has been regarded as the most powerful candidate light-emitting device at present. Meanwhile, in the optical communication, a data rate is dependent on a response speed of the light-emitting device. Therefore, a light-emitting device with the higher-speed response performance such as a laser diode (LD) or a super luminescent diode (SLD) also attracts much attention.

[0004] The basic principle of implementing the visible light communication is that: a certain kind of modulation such as pulse width modulation (PWM), pulse position/frequency modulation (PPM) or pulse amplitude modulation (PAM) is performed on the light emitted by the light-emitting device; the modulated light energy is used as data to be transmitted, and transmitted through a spatial channel and received by a photoelectric detector (a sensor) on the target device; and the photoelectric detector converts the received optical signal into an electrical signal and then demodulates the sent data through the follow-up processing. The target device can be a common portable device attached with such function of transmitting the data through the visible light, such as a mobile phone, a digital camera and a notebook computer and so on. Similar to the constitution of the wireless local area network, the portable terminals constitute the nodes in the network, that is, the visible light communication technology can serve as the local area network technology or the underlying technology applied in an access network.

[0005] According to the future application scenarios and characteristics of the visible light, the multiple input multiple output (MIMO) may become the mainstream application mode in various scenarios. Moreover, there will be more and more various portable devices equipped with cameras. It is not difficult to imagine that using various LEDs as an information releasing system and various portable/mobile terminals as a receiving system is a simple and convenient communication mode. At present, there has been no specific method for implementing the visible light communication in the industry.

[0006] The document "CN102684819A" discloses a data transmission method, which includes: A transmitter performs scrambling, constellation modulation, and multiple-input multiple-output precoding processing sequentially on downlink user data to obtain a precoded symbol sequence; performs time-frequency resource mapping on the precoded symbol sequence to obtain frequency domain data of an OFDM symbol; performs conjugate symmetric extension and IFFT on the frequency domain data of the OFDM symbol to obtain a time domain real-number sequence; performs CP insertion processing on the time domain real-number sequence to form a first downlink time domain baseband signal; loads the first downlink time domain baseband signal onto a direct current of a LED lighting circuit to form a LED driving electrical signal; and converts the LED driving electrical signal into a visible beam of the LED for transmission.

Summary of the Invention

[0007] The present invention provides a method and system for implementing visible light communication, a sending apparatus and a receiving apparatus, which can implement the visible light communication, to meet the demand for application scenarios of the visible light in the future.

[0008] In order to solve the above technical problem, the present invention discloses a method for implementing visible light communication, which comprises: after performing constellation modulation on data to be sent, a sending end mapping a modulated signal to a corresponding luminescent light source; and
transmitting the data to be sent to a receiving end through an optical signal, and the receiving end converting the received optical signal into an electrical signal; and
the receiving end determining a constellation modulation signal according to a luminescent light source corresponding to the received signal, and demodulating the constellation modulation signal to obtain received data.

[0009] Preferably, before the method, it further comprises: performing encoding on the data to be sent, and performing constellation modulation on an encoded signal.

[0010] Preferably, before the method, it further comprises: presetting a mapping relationship between a constellation modulation signal and a location where the luminescent light source is located;

Said mapping a modulated signal to a corresponding luminescent light source comprises: mapping a signal of a constellation point on which the constellation modulation is performed to a luminescent light source corresponding to the constellation point, according to the mapping relationship.

[0011] Preferably, said transmitting the data to be sent to a receiving end through an optical signal comprises: opening the corresponding luminescent light source, and transmitting the data to be sent to the receiving end through the optical signal.

[0012] Preferably, said opening the corresponding luminescent light source comprises: driving the electrical signal on which the constellation modulation is performed, and opening a luminescent light source on a constellation point corresponding to the modulated signal.

[0013] Preferably, after the receiving end converts the received optical signal into the electrical signal, the method further comprises: performing filter shaping processing on the electrical signal obtained through the conversion.

[0014] Preferably, when the receiving end is started, the method further comprises: pre-positioning a location of the luminescent light source in a constellation diagram.

[0015] Preferably, the pre-positioning comprises: the sending end simultaneously opening all luminescent light sources corresponding to constellation modulation in different modulation modes, or simultaneously opening luminescent light sources in part of particular locations; and
the receiving end identifying a location of each luminescent light source corresponding to each constellation point in different modulation modes by positioning a light source matrix, and establishing a mapping relationship between a constellation modulation signal and a location where the luminescent light source is located consistent with that of the sending end.

[0016] Preferably, determining a constellation modulation signal according to the luminescent light source corresponding to the received signal comprises: according to the established mapping relationship, mapping a location of the luminescent light source where the received optical signal is located to a constellation modulation signal corresponding to the constellation point.

[0017] The present invention further provides a system for implementing visible light communication, which comprises: a sending end and a receiving end;
the sending end is configured to: after performing constellation modulation on data to be sent, map a modulated signal to a corresponding luminescent light source; and transmit the data to be sent to the receiving end through an optical signal; and
the receiving end is configured to: receive the optical signal from the sending end and convert the optical signal into an electrical signal; and determine a constellation modulation signal according to a luminescent light source corresponding to the received signal, and demodulate the constellation modulation signal to obtain received data.

[0018] Preferably, the sending end at least comprises: a signal preprocessing unit, a mapping unit and a signal output unit, wherein,
the signal preprocessing unit is configured to: perform preprocessing on the data to be sent and then output the preprocessed data to be sent to the mapping unit, wherein the preprocessing comprises encoding and constellation modulation;
the mapping unit is configured to: be set with a mapping relationship between a constellation modulation signal and a location where the luminescent light source is located; and map the modulated signal to the corresponding luminescent light source according to the set mapping relationship and then output the modulated signal to the signal output unit; and
the signal output unit is configured to: convert an electrical signal from the mapping unit into an optical signal, and transmit the optical signal obtained through the conversion to the receiving end.

[0019] Preferably, the luminescent light source is independent, or is a luminescent point independently opened in a luminescent panel.

[0020] Preferably, the receiving terminal at least comprises: a signal receiving unit, an inverse mapping unit and a signal processing unit, wherein,
the signal receiving unit is configured to: convert the optical signal from the sending end into the electrical signal and then output the electrical signal to the inverse mapping unit;
the inverse mapping unit is configured to: according to an established mapping relationship between a constellation modulation signal and a location where the luminescent light source is located, map a location of the luminescent light source where the received optical signal is located into a constellation modulation signal corresponding to a constellation point, and output the obtained constellation modulation signal to the signal processing unit; and
the signal processing unit is configured to: perform processing on the constellation modulation signal from the inverse mapping unit to obtain the data sent by the sending end; wherein the processing comprises modulation and decoding.

[0021] The signal receiving unit is further configured to: perform filter shaping processing on the received optical signal.

[0022] The sending end is further configured to: simultaneously open all luminescent light sources corresponding to constellation modulation in different modulation modes, or simultaneously open luminescent light sources in part of particular locations;
the receiving end is further configured to: identify a location of each luminescent light source corresponding to each constellation point in different modulation modes by positioning a light source matrix, and establish a mapping relationship between a constellation modulation signal and a location where the luminescent light source is located consistent with that of the sending end.

[0023] Preferably, when the constellation modulation is quaternary phase shift keying (QPSK) signal modulation, a number of the luminescent light sources is 4;
when the constellation modulation is quadrature amplitude modulation with 16 kinds of symbols

(16QAM), a number of the luminescent light sources is 16; and
when the constellation modulation is quadrature amplitude modulation with 64 kinds of symbols (64QAM), a number of the luminescent light sources is 64.

[0024] The present invention further provides a sending apparatus, which is configured to: after performing constellation modulation on data to be sent, map a modulated signal to a corresponding luminescent light source; and send the data to be sent throughan optical signal.

[0025] Preferably, the sending apparatus at least comprises: a signal preprocessing unit, a mapping unit and a signal output unit, wherein,
the signal preprocessing unit is configured to: perform preprocessing on the data to be sent and then output the preprocessed data to be sent to the mapping unit, wherein the preprocessing comprises encoding and constellation modulation;
the mapping unit is configured to: be set with a mapping relationship between a constellation modulation signal and a location where the luminescent light source is located; and map the modulated signal to the corresponding luminescent light source according to the set mapping relationship and then output the modulated signal to the signal output unit; and
the signal output unit is configured to: convert an electrical signal from the mapping unit into an optical signal, and transmit the optical signal obtained through the conversion to a receiving end.

[0026] Preferably, the sending apparatus is further configured to: simultaneously open all luminescent light sources corresponding to constellation modulation in different modulation mode, or simultaneously open luminescent light sources in part of particular locations.

[0027] When the constellation modulation is quaternary phase shift keying (QPSK) signal modulation, a number of the luminescent light sources is 4;
when the constellation modulation is quadrature amplitude modulation with 16 kinds of symbols (16QAM), a number of the luminescent light sources is 16; and
when the constellation modulation is quadrature amplitude modulation with 64 kinds of symbols (64QAM), a number of the luminescent light sources is 64.

[0028] The present invention further provides a receiving apparatus, which is configured to: convert a received optical signal into an electrical signal; and determine a constellation modulation signal according to a luminescent light source corresponding to the received signal, and demodulate the constellation modulation signal to obtain received data.

[0029] Preferably, the receiving apparatus at least comprises: a signal receiving unit, an inverse mapping unit and a signal processing unit, wherein,
the signal receiving unit is configured to: convert an optical signal from a sending end into an electrical signal and then output the electrical signal to the inverse mapping unit;
the inverse mapping unit is configured to: according to an established mapping relationship between a constellation modulation signal and a location where the luminescent light source is located, map a location of the luminescent light source where the received optical signal is

located to a constellation modulation signal corresponding to a constellation point, and output the obtained constellation modulation signal to the signal processing unit; and
the signal processing unit is configured to: perform processing on the constellation modulation signal from the inverse mapping unit to obtain the data sent by the sending end; wherein the processing comprises modulation and decoding.

[0030] Preferably, the signal receiving unit is further configured to: perform filter shaping processing on the received optical signal.

[0031] Preferably, the receiving apparatus is further configured to: identify a location of each luminescent light source corresponding to each constellation point in different modulation modes by positioning a light source matrix, and establish a mapping relationship between a constellation modulation signal and a location where the luminescent light source is located consistent with that of a sending apparatus.

[0032] The technical scheme of the present application comprises: after performing constellation modulation on data to be sent, a sending end mapping a modulated signal to a corresponding luminescent light source; and transmitting the data to be sent to a receiving end through an optical signal, and the receiving end converting a received optical signal into an electrical signal; and the receiving end determining a constellation modulation signal according to a luminescent light source corresponding to the received signal, and demodulating the constellation modulation signal to obtain received data. In the method of the embodiment of the present invention, the sending end places light sources of the visible light according a constellation diagram form of the constellation modulation, and maps the signal obtained after the constellation modulation is performed on the data to be sent to a luminescent light source corresponding to the location of the constellation point and drives the luminescent light source, thereby transmitting the data to be sent to the receiving end through the optical signal; and the receiving terminal determines a constellation modulation signal corresponding to the constellation point according to the location of the luminescent light source, to acquire the data from the sending end. With the above method, the visible light communication is implemented, which meets the demand for application scenarios of the visible light in the future.

Brief Description of Drawings

[0033] Here, the described accompanying drawings are used to provide a further understanding of the present invention and constitute a part of the present application. The schematic embodiments and illustrations thereof of the present invention are used to explain the present invention, but do not constitute an inappropriate limitation on the present invention. In the drawings:

FIG. 1 is a flow chart of a method for implementing visible light communication according to the embodiment of the present invention.

FIG. 2 is a first implementation schematic diagram of a corresponding relationship between locations of light sources and a constellation diagram according to the present invention.

FIG. 3 is a second implementation schematic diagram of a corresponding relationship between locations of light sources and a constellation diagram according to the present invention.

FIG. 4 is a third implementation schematic diagram of a corresponding relationship between locations of light sources and a constellation diagram according to the present invention.

FIG. 5 is a schematic diagram of a composition structure of a system for implementing visible light communication according to the embodiment of the present invention.

Preferred Embodiments of the Invention

[0034] FIG. 1 is a flow chart of a method for implementing visible light communication according to the present invention, and as shown in FIG. 1, the following steps are included.

[0035] In step 100, after performing constellation modulation on data to be sent, a sending end maps a modulated signal to a corresponding luminescent light source.

[0036] In the step, luminescent light sources of the visible light are placed in simulation to the form of locations of the constellation points after the constellation modulation is performed, and a mapping relationship between a constellation modulation signal and a location where the luminescent light source is located is preset. According to characteristics of the constellation modulation, for example, when a quaternary phase shift keying (QPSK) signal is a 2bit byte and QPSK modulation is adopted, 4 constellation points can be generated, and thus 4 luminescent light sources are required to correspond to the 4 constellation points respectively; for another example, when quadrature amplitude modulation with 16 kinds of symbols (16QAM) is a 4bit byte and the 16QAM modulation is adopted, 16 constellation points can be generated, and thus 16 luminescent light sources are required to correspond to the 16 constellation points respectively; and for another example, when quadrature amplitude modulation with 64 kinds of symbols (64QAM) is a 6bit byte and the 64QAM modulation is adopted, 64 constellation points can be generated, and thus 64 luminescent light sources are required to correspond to the 64 constellation points respectively, and so forth. It is not difficult to understand that other constellation modulation ison the analogy of this: 2^n luminescent light sources can transmit n-byte constellation modulation information at each moment, and during the data transmission, the luminescent light source corresponding to only one constellation point is opened at each moment.

[0037] For example, FIG. 2 is a first implementation schematic diagram of a corresponding relationship between locations of light sources and a constellation diagram according to the present invention, the constellation modulation is the QPSK modulation in FIG. 2, the placement locations of the luminescent light sources are as shown in FIG. 2, and double-loop circles represent 4 luminescent light sources respectively corresponding to different constellation points in the FIG. 2. FIG. 3 is a second implementation schematic diagram of a corresponding relationship between locations of light sources and a constellation diagram according to the present invention, the constellation modulation is the 16QAM modulation in FIG. 3, the placement locations of the luminescent light sources are as shown in FIG. 3, and double-loop circles represent 16 luminescent light sources respectively corresponding to different constellation points in the FIG. 3. FIG. 4 is a third implementation schematic diagram of a corresponding relationship between locations of light sources and a constellation diagram according to the present invention, the constellation modulation is the 64QAM modulation in FIG. 4, the placement locations of the luminescent light sources are as shown in FIG. 4, and double-loop circles represent 64 luminescent light sources respectively corresponding to different constellation points in the FIG. 4.

[0038] Wherein, each luminescent light source can be independent, and it also can be a luminescent point that can be independently opened in a luminescent panel. It should be noted that a separation distance between the luminescent points is required to satisfy that the receiving end can identify different luminescent points, and with respect to how to specifically determine the separation distance between the luminescent points, it should be easily implemented by the people skilled in the art according to the actual conditions, which is not limited here.

[0039] In the step, mapping the modulated signal to the corresponding luminescent light source includes: according to the preset mapping relationship between the constellation modulation signal and the location where the luminescent light source is located, mapping a signal of a constellation point on which the constellation modulation is currently performed to a luminescent light source corresponding to the constellation point. After the constellation modulation is performed, a throughput of transmitting data streams becomes n times of not performing the constellation modulation.

[0040] In the step, before performing constellation modulation on the data to be sent, it further includes: performing encoding on the data to be sent, and performing constellation modulation on an encoded signal. Wherein, the specific implementation of the encoding and constellation modulation belongs to the common technical means of the people skilled in the art, which will not be repeated here.

[0041] In step 101, the data to be sent are transmitted to a receiving end through an optical signal, and the receiving end converts the received optical signal into an electrical signal.

[0042] In the step, transmitting the data to be sent to the receiving end through the optical signal includes: opening the corresponding luminescent light source, and transmitting the data to be sent to the receiving end through the optical signal. Wherein, opening the corresponding luminescent light source specifically includes: driving the electrical signal on which the constellation modulation is performed, and opening a luminescent light source on a constellation point corresponding to the modulated signal, thereby completing a conversion from the electrical signal to the optical signal.

[0043] The receiving terminal converting the received optical signal into the electrical signal belongs to the common technical means of the people skilled in the art, and the specific implementation thereof is not used to limit the protection scope of the present invention, which will not be repeated here.

[0044] In the step, after the receiving terminal converts the received optical signal into the electrical signal, it further includes: performing filter shaping processing on the electrical signal obtained through conversion. The specific implementation belongs to the common technical means of the people skilled in the art, which is not used to limit the protection scope of the present invention, and will not be repeated here.

[0045] In step 102, the receiving end determines a constellation modulation signal according to a luminescent light source corresponding to the received signal, and demodulates the constellation modulation signal to obtain received data.

[0046] Before the step, when the receiving end equipment is started, the method also includes: pre-positioning a location of the luminescent light source in a constellation diagram. That is to say, before the communication, the sending end simultaneously opens all luminescent light sources corresponding to constellation modulation in different modulation modes (or simultaneously opens luminescent light sources in part of particular locations), and the receiving end identifies a location of each luminescent light source corresponding to each constellation point in different modulation modes by positioning a light source matrix, thereby establishing a mapping relationship between a constellation modulation signal and a location where the luminescent light source is located consistent with that of the sending end at the receiving end. Therefore,
determining the constellation modulation signal according to the luminescent light source corresponding to the received signal in the step includes: mapping a location of the luminescent light source where the received optical signal is located to a constellation modulation signal corresponding to the constellation point according to the established mapping relationship between the constellation modulation signal and the location where the luminescent light source is located.

[0047] In the step, processing including demodulation and decoding, etc., is performed on the mapped constellation modulation signal on the constellation point to obtain the received data. The specific implementation belongs to the common technical means of the people skilled in the art, which will not be repeated here.

[0048] In the method of the present invention, the sending end places light sources of the visible light according a constellation diagram form of the constellation modulation, and maps the signal obtained after the constellation modulation is performed on the data to be sent to a luminescent light source corresponding to the location of the constellation point and drives the luminescent light source, thereby transmitting the data to be sent to the receiving end through the optical signal; and the receiving terminal determines a constellation modulation signal corresponding to the constellation point according to the location of the luminescent light source, to acquire the data from the sending end. Through the method of the present invention, the visible light communication is implemented, which meets the demand for application scenarios of the visible light in the future.

[0049] The present invention also provides a system for implementing visible light communication, and as shown in FIG. 5, a sending end and a receiving end are included, wherein,
the sending end is configured to: after performing constellation modulation on data to be sent, map a modulated signal to a corresponding luminescent light source; and transmit the data to be sent to the receiving end through an optical signal; and
the receiving end is configured to: receive the optical signal from the sending end and convert the optical signal into an electrical signal; and determine a constellation modulation signal according to a luminescent light source corresponding to the received signal, and demodulate the constellation modulation signal to obtain received data.

[0050] The sending end at least includes: a signal preprocessing unit, a mapping unit and a signal output unit, wherein,
the signal preprocessing unit is configured to: perform preprocessing on the data to be sent and then output the data to be sent to the mapping unit, wherein the preprocessing can include encoding and constellation modulation;
the mapping unit, in which a mapping relationship between a constellation modulation signal and a location where the luminescent light source is located is set, is configured to: according to the set mapping relationship, map the modulated signal to the corresponding luminescent light source and then output the modulated signal to the signal output unit; and
the signal output unit is configured to: convert an electrical signal from the mapping unit into an optical signal, and transmit the optical signal obtained through conversion to the receiving end.

[0051] Wherein, each luminescent light source can be independent, and it also can be a luminescent point that can be independently opened in a luminescent panel. It should be noted that a separation distance between the luminescent points is required to satisfy that the receiving end can identify different luminescent points, and with respect to how to specifically determine the separation distance between the luminescent points, it should be easily implemented by the people skilled in the art according to the actual conditions, which is not limited here.

[0052] The receiving terminal at least includes: a signal receiving unit, an inverse mapping unit and a signal processing unit, wherein,
the signal receiving unit is configured to: convert the optical signal from the sending end into the electrical signal and then output the electrical signal to the inverse mapping unit; and it is further configured to perform filter shaping processing on the received optical signal.

[0053] The inverse mapping unit is used to: according to an established mapping relationship between a constellation modulation signal and a location where the luminescent light source is located, map a location of the luminescent light source where the received optical signal is located to a constellation modulation signal corresponding to a constellation point, and output the obtained constellation modulation signal to the signal processing unit; and
the signal processing unit is configured to: perform processing on the constellation modulation signal from the inverse mapping unit to obtain the data sent by the sending end. The processing therein includes modulation and decoding and so on.

[0054] Furthermore,
the sending end is also configured to: simultaneously open all luminescent light sources corresponding to constellation modulation in different modulation modes, or simultaneously open luminescent light sources in part of particular locations;
the receiving end is also configured to: identify a location of each luminescent light source corresponding to each constellation point in different modulation modes by positioning a light source matrix, and establish a mapping relationship between a constellation modulation signal and a location where the luminescent light source is located consistent with that of the sending end. It should be noted that, in order to perform location calibration, such as a plurality of location possibilities corresponding to the QPSK, 16QAM and 64QAM modulation modes shown in FGI. 2 to FIG. 4, the receiving end is just required to indentify the location by positioning the light source matrix. The specific implementation belongs to the common knowledge of the people skilled in the art, which is not used to limit the protection scope of the present invention.

[0055] When the constellation modulation is quaternary phase shift keying (QPSK) signal modulation, the number of the luminescent light sources is 4; when the constellation modulation is quadrature amplitude modulation with 16 kinds of symbols (16QAM), the number of the luminescent light sources is 16; and when the constellation modulation is quadrature amplitude modulation with 64 kinds of symbols (64QAM), the number of the luminescent light sources is 64.

[0056] The present invention also provides a sending apparatus for implementing visible light communication, which is configured to: after performing constellation modulation on data to be sent, map a modulated signal to a corresponding luminescent light source; and send the data to be sent by means of optical signal. A signal preprocessing unit, a mapping unit and a signal output unit are at least included, wherein,
the signal preprocessing unit is configured to: perform preprocessing on the data to be sent and then output the data to be sent to the mapping unit, wherein the preprocessing can include encoding and constellation modulation;
the mapping unit, in which a mapping relationship between a constellation modulation signal and a location where the luminescent light source is located is set, is configured to: map the modulated signal to the corresponding luminescent light source according to the set mapping relationship and then output the modulated signal to the signal output unit; and
the signal output unit is configured to: convert an electrical signal from the mapping unit into an

optical signal, and transmit the optical signal obtained through conversion to a receiving end.

[0057] The sending apparatus is also configured to: simultaneously open all luminescent light sources corresponding to constellation modulation in different modulation modes, or simultaneously open luminescent light sources in part of particular locations.

[0058] The present invention also provides a receiving apparatus for implementing visible light communication, which is configured to: convert a received optical signal into an electrical signal; and determine a constellation modulation signal according to a luminescent light source corresponding to the received signal, and demodulate the constellation modulation signal to obtain received data. A signal receiving unit, an inverse mapping unit and a signal processing unit are at least included, wherein,
the signal receiving unit is configured to: convert an optical signal from a sending end into an electrical signal and then output the electrical signal to the inverse mapping unit; and it is further configured to perform filter shaping processing on the received optical signal.

[0059] The inverse mapping unit is configured to: according to an established mapping relationship between a constellation modulation signal and a location where the luminescent light source is located, map a location of the luminescent light source where the received optical signal is located to a constellation modulation signal corresponding to a constellation point, and output the obtained constellation modulation signal to the signal processing unit; and the signal processing unit is configured to: perform processing on the constellation modulation signal from the inverse mapping unit to obtain the data sent by the sending end. The processing therein includes modulation and decoding and so on.

[0060] The receiving apparatus is also configured to: by recording a location of each luminescent light source corresponding to each constellation point in different modulation modes, establish a mapping relationship between a constellation modulation signal and a location where the luminescent light source is located consistent with that of the sending apparatus.

Industrial Applicability

[0061] In the method of the embodiment of the present invention, the sending end places light sources of the visible light according a constellation diagram form of the constellation modulation, and maps the signal obtained after the constellation modulation is performed on the data to be sent to a luminescent light source corresponding to the location of the constellation point and drives the luminescent light source, thereby transmitting the data to be sent to the receiving end through the optical signal; and the receiving terminal determines a constellation modulation signal corresponding to the constellation point according to the location of the luminescent light source, to acquire the data from the sending end. With the above method, the visible light communication is implemented, which meets the demand for application scenarios of the visible light in the future.

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- CN102684819A **[0006]**

Krav

1. En metode til implementering af kommunikation via synligt lys, **kendetegnet ved at** omfatte:
forudindstilling af en tilknytningsrelation mellem hvert konstellationsmodulerede signal og en placering, hvor en selvlysende lyskilde er placeret; efter udførelse af konstellationsmodulering af data, der skal sendes, en sendende ende, der knytter det modulerede signal til en tilsvarende selvlysende lyskilde (100); og transmittering af de data, der skal sendes, til en modtagende ende gennem et optisk signal, og den modtagende ende konverterer det modtagne optiske signal til et elektrisk signal (101); og den modtagende ende bestemmer et konstellationsmoduleret signal i henhold til en selvlysende lyskilde, der svarer til det modtagne signal, og demodulering af det konstallationsmodulerede signal for at opnå modtagne data (102); hvor nævnte tilknytning af det modulerede signal til en tilsvarende selvlysende lyskilde omfatter:
tilknytning af et konstellationspunkt, der svarer til det modulerede signal, til en selvlysende lyskilde, der svarer til konstellationspunktet i forhold til tilknytningsrelationen.

2. Metode i henhold til krav 1, hvor, før metoden, følgende desuden er omfattet: udførelse af kodning af de data, der skal sendes, og udførelse af konstellationsmodulering af det kodede signal.

3. Metoden i henhold til krav 1, hvor nævnte transmittering af de data, der skal sendes til en modtagende ende gennem et optisk signal, omfatter: åbning af den tilsvarende selvlysende lyskilde og transmittering af de data, der skal sendes, til den modtagende ende gennem det optiske signal, helst, hvor nævnte åbning af den tilsvarende selvlysende lyskilde omfatter: føring af et elektrisk signal for det modulerede signal, og åbning af en selvlysende lyskilde på det konstellationspunkt, der svarer til det modulerede signal.

4. Metode i henhold til krav 1 eller 2, hvor, efter den modtagende ende konverterer det modtagne optiske signal til det elektriske signal, metoden desuden omfatter:
gennemførelse af filterformende behandling af det elektriske signal, der opnås gennem konverteringen, helst, hvor, når den modtagende ende er startet, metoden desuden omfatter: forudpositionering af en placering af den selvlysende lyskilde i et konstellationsdiagram.

5. Metoden i henhold til krav 4, hvor forudpositioneringen omfatter: at den sendende ende samtidigt åbner alle selvlysende lyskilder, der svarer til konstellationsmodulation i forskellige modulationstilstande, eller samtidigt åbner selvlysende lyskilder i dele af bestemte placeringer; og den modtagende ende identificerer en placering af hver selvlysende lyskilde, som svarer til hvert konstellationspunkt i forskellige moduleringstilstande, ved at placere en lyskildematrice og etablere en tilknytningsrelation mellem hvert konstellationsmodulerede signal og en placering, hvor den selvlysende lyskilde er placeret konsistent med den for den sendende ende, helst, hvor nævnte bestemmelse af det konstellationsmodulerede signal i henhold til en selvlysende lyskilde, der svarer til det modtagne signal, omfatter: i forhold til den etablerede tilknytningsrelation tilknytning af en placering af den selvlysende lyskilde, hvor det modtagne optiske signal er placeret til det konstellationsmodulerede signal, der svarer til konstellationspunktet.

6. Et system til implementering af kommunikation via synligt lys, **kendetegnet ved, at** omfatte: en sendende ende og en modtagende ende; hvor den sendende ende er konfigureret til: efter udførelse af konstellationsmodulering af data, der skal sendes, at knytte det modulerede signal til en tilsvarende selvlysende lyskilde; og transmittere de data, der skal sendes, til den modtagende ende gennem et optisk signal; og den modtagende ende er konfigureret til: at modtage det optiske signal fra den sendende ende og konvertere det optiske signal til et elektrisk signal; og bestemme det konstellationsmodulerede signal i henhold til en selvlysende lyskilde, der svarer til det modtagne signal, og demodulere det konstellationsmodulerede signal for at opnå modtagne data; hvor den sendende ende mindst omfatter: en signalforbehandlingsenhed, en tilknytningsenhed og en signaludgangsenhed; signalforbehandlingsenheden er konfigureret til: at udføre forbehandling af de data, der skal sendes, og derefter udsende de forbehandlede data, der skal sendes, til tilknytningsenheden, hvor forbehandlingen omfatter kodning og konstellationsmodulering; tilknytningsenheden er konfigureret til: at blive indstillet med en tilknytningsrelation mellem hvert konstellationsmodulerede signal og en placering, hvor den selvlysende lyskilde er placeret; og i forhold til den indstillede tilknytningsrelation knytte et konstellationspunkt, der svarer til det modulerede signal, til en selvlysende lyskilde, der svarer til konstellationspunktet, og derefter udsende det modulerede signal til signaludgangsenheden; og signaludgangsenheden er konfigureret til: at konvertere et elektrisk signal fra tilknytningsenheden til et optisk signal og transmittere det optiske signal, der er opnået gennem konverteringen, til den modtagende ende.

7. Systemet i henhold til krav 6, hvor den selvlysende lyskilde er uafhængig, eller er et selvlysende punkt, der åbnes separat i et selvlysende panel.

8. Systemet i henhold til krav 6 eller 7, hvor, når konstellationsmoduleringen er signalmodulering med kvaternær faseskiftemodulation (QPSK), et antal af de selvlysende lyskilder er 4; når konstellationsmoduleringen er kvaternær amplitudemodulation med 16 slags symboler (16QAM), et antal af selvlysende lyskilder er 16; og når konstellationsmoduleringen er kvaternær amplitudemodulation med 64 slags symboler (64QAM), et antal af de selvlysende lyskilder er 64.

9. Systemet i henhold til krav 6, hvor den modtagende ende mindst omfatter: en signalmodtagelsesenhed, en enhed til omvendt tilknytning og en signalbehandlingsenhed, hvor signalmodtagelsesenheden er konfigureret til: at konvertere det optiske signal fra den sendende ende ind i det elektriske signal og derefter udsende det elektriske signal til enheden til omvendt tilknytning; enheden til omvendt tilknytning er konfigureret til: i henhold til en etableret tilknytningsrelation mellem hvert konstellationsmodulerede signal og en placering, hvor den selvlysende lyskilde er placeret, at tilknytte en placering af den selvlysende lyskilde, hvor det modtagne optiske signal er placeret til et konstellationsmoduleret signal, der svarer til et konstellationspunkt, og udsende det opnåede konstellationsmodulerede signal til signalbehandlingsenheden; og signalbehandlingsenheden er konfigureret til: at udføre behandling af det konstellationsmodulerede signal fra enheden til omvendt tilknytning for at opnå de data, der blev sendt fra den sendende ende; hvor behandlingen omfatter modulation og afkodning, helst, hvor signalmodtagelsesenheden desuden er konfigureret til at udføre filterformende behandling af det modtagne optiske signal.

10. Systemet i henhold til krav 6, hvor den sendende ende desuden er konfigureret til: samtidigt at åbne alle selvlysende lyskilder, der svarer til konstellationsmoduleringen i forskellige modulationstilstande, eller samtidigt åbne selvlysende lyskilder i dele af bestemte placeringer; den modtagende ende desuden er konfigureret til: at identificere en placering af hver selvlysende lyskilde, som svarer til hvert konstellationspunkt i forskellige modulationstilstande, ved at positionere en lyskildematrice og etablere en tilknytningsrelation mellem hvert konstellationsmodulerede signal og en placering, hvor den selvlysende lyskilde er placeret konsistent med den fra den sendende ende.

11. Et sendeapparat, **kendetegnet ved, at** sendeapparatet er konfigureret til: efter udførelse af konstellationsmodulering på data, der skal sendes, at knytte det modulerede signal til en tilsvarende selvlysende lyskilde; og sende de data, der skal sendes, gennem et optisk signal; hvor sendeapparatet mindst omfatter: en signalforbehandlingsenhed, en tilknytningsenhed og en signaludgangsenhed; signalforbehandlingsenheden er konfigureret til: at udføre forbehandling af de data, der skal sendes, og derefter udsende de forbehandlede data, der skal sendes, til tilknytningsenheden, hvor forbehandlingen omfatter kodning og konstellationsmodulering; tilknytningsenheden er konfigureret til: at blive indstillet med en tilknytningsrelation mellem hvert konstellationsmodulerede signal og en placering, hvor den selvlysende lyskilde er placeret; og knytte et konstellationspunkt, der svarer til det modulerede signal, til en selvlysende lyskilde, der svarer til konstellationspunktet i henhold til den angivne tilknytningsrelation, og derefter udsende det modulerede signal til signaludgangsenheden; og signaludgangsenheden er konfigureret til: at konvertere et elektrisk signal fra tilknytningsenheden til et optisk signal og transmittere det optiske signal, der er opnået gennem konverteringen, til en modtagende ende.

12. Sendeapparatet i henhold til krav 11, hvor sendeapparatet desuden er konfigureret til: samtidigt at åbne alle selvlysende lyskilder, der svarer til konstellationsmodulationen, i forskellige modulationstilstande eller samtidigt åbne selvlysende lyskilder i dele af bestemte placeringer.

13. Sendeapparatet i henhold til krav 11 eller 12, hvor, når konstellationsmoduleringen er signalmodulering med kvaternær faseskiftemodulation (QPSK), et antal af de selvlysende lyskilder er 4; når konstellationsmoduleringen er kvaternær amplitudemodulation med 16 slags symboler (16QAM), et antal af selvlysende lyskilder er 16; og når konstellationsmoduleringen er kvaternær amplitudemodulation med 64 slags symboler (64QAM), et antal af de selvlysende lyskilder er 64.

14. Et modtageapparat, **kendetegnet ved, at** modtageapparatet er konfigureret til: at konvertere et modtaget optisk signal til et elektrisk signal; og bestemme et konstellationsmoduleret signal i henhold til en selvlysende lyskilde, der svarer til det modtagne signal, og demodulere det konstellationsmodulerede signal for at opnå modtagne data; hvor modtageapparatet omfatter: en signalmodtagelsesenhed, en enhed til omvendt tilknytning og en signalbehandlingsenhed, hvor signalmodtagelsesenheden er konfigureret til: at konvertere et optisk signal fra en sendende ende ind i et elektrisk signal og derefter udsende det elektriske signal til enheden til omvendt tilknytning; enheden til omvendt tilknytning er konfigureret til: i henhold til en etableret tilknytningsrelation mellem et konstellationsmoduleret signal og en placering, hvor den selvlysende lyskilde er placeret, at tilknytte en placering af den selvlysende lyskilde, hvor det modtagne optiske signal er placeret, til det konstellationsmodulerede signal, der svarer til et konstellationspunkt, og udsende det opnåede konstellationsmodulerede signal til signalbehandlingsenheden; og signalbehandlingsenheden er konfigureret til: at udføre behandling af det konstellationsmodulerede signal fra enheden til omvendt tilknytning for at opnå de data, der blev sendt fra den sendende ende; hvor behandlingen omfatter modulation og afkodning.

15. Modtageapparatet i henhold til krav 14, hvor signalmodtagelsesenheden desuden er konfigureret til: at udføre filterformende behandling af det modtagne optiske signal, eller, hvor modtageapparatet desuden er konfigureret til: at identificere en placering af hver selvlysende lyskilde, som svarer til hvert konstellationspunkt, i forskellige modulationstilstande ved at positionere en lyskildematrice og etablere en tilknytningsrelation mellem hvert konstellationsmodulerede signal og en placering, hvor den selvlysende lyskilde er placeret konsistent med den fra et sendeapparat.

DRAWINGS

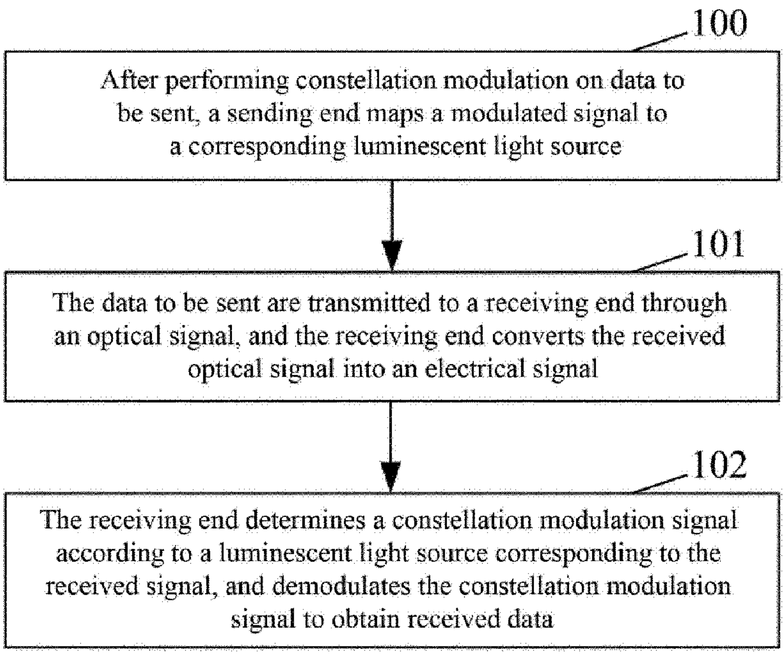

FIG. 1

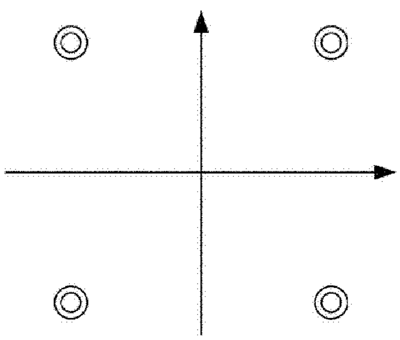

FIG. 2

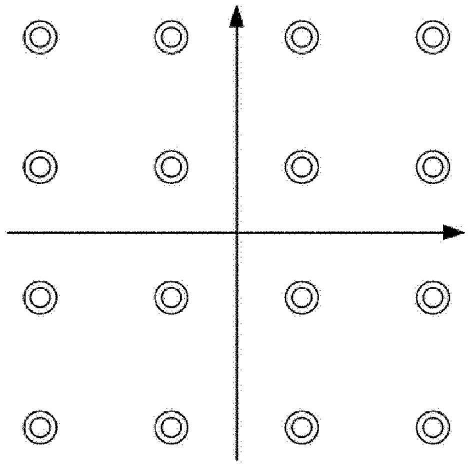

FIG. 3

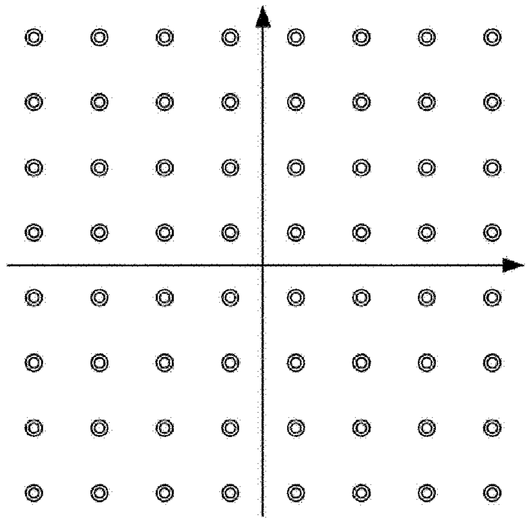

FIG. 4

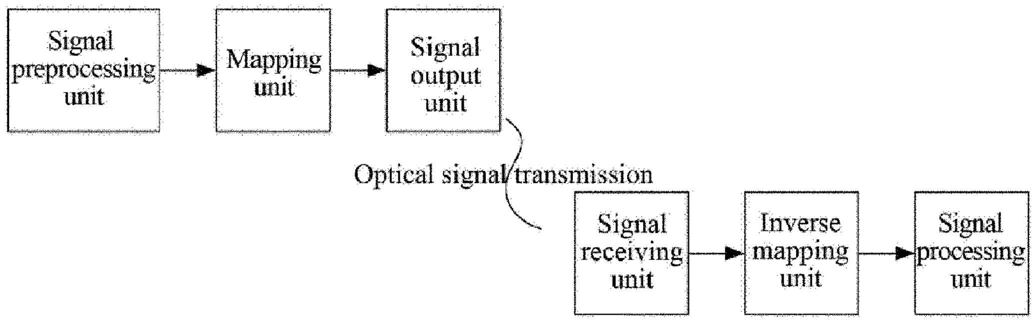
Signal preprocessing unit
Mapping unit
Signal output unit
Optical signal transmission
Signal receiving unit
Inverse mapping unit
Signal processing unit

FIG. 5