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(73) Patenthaver: **King Abdulaziz City for Science and Technology, , P.O. Box 6086, Riyadh 11442, Saudi-Arabien**

(72) Opfinder: **Al-Omari, Hussein Khalid, P.O. Box 2750, 11953 Amman, Jordan**
Khorsheed, Mohammad Sulaiman, King Abdulaziz City For Science & Technology, Building 17, Block f, Office 415, P.O. Box 6086, 11443 Riyadh, Saudi-Arabien

(74) Fuldmægtig i Danmark: **Chas. Hude A/S, H.C. Andersens Boulevard 33, 1780 København V, Danmark**

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(56) Fremdragne publikationer:
JP-A- 10 283 446
US-A- 4 924 078
US-A1- 2004 182 930
US-A1- 2005 285 761
US-A1- 2008 000 991
US-A1- 2009 230 193
US-A1- 2009 242 650
US-A1- 2011 290 882
US-A1- 2014 144 991
US-B1- 7 913 922

DESCRIPTION

FIELD OF THE INVENTION

[0001] The invention generally relates to a multidimensional color barcode. More specifically, the invention relates to a method for generating a multidimensional color barcode.

BACKGROUND OF THE INVENTION

[0002] A black and white barcode is very widely used for recording digital information which is readable by an apparatus in a small space on a printed matter. However, such black and white barcodes have limited abilities in terms of recording information including large data such as a long document or a picture.

[0003] Originally black and white barcodes systematically represented data by varying the widths and spacing of parallel lines, and were referred to as linear or one-dimensional. Currently two dimensional barcodes are prevalent, the two dimensional codes use varieties of symbols like rectangles, dots, hexagons and other geometric patterns to store information.

[0004] As with increase in the storage requirement, color barcodes were introduced, as the color barcodes can store much more information than the black and white barcodes. The black and white barcodes record information using binary encoding, whereas color barcodes encode information using several colors by multi valued recording.

[0005] For decoding information from the color barcodes, scanners scan the various colors of the color barcodes. However, as the color barcodes go through usual wear and tear due to their age and/or constant usage, it becomes difficult to distinguish between colors of the color barcode using a scanner. Further, at times, a reference, associated with a color barcode, which is used to decode information encoded in a data of a color barcode also gets degraded over a time, this leads to error/difficulty in decoding the information.

[0006] In a two-dimensional code according to US 2004/0182930 A1, a plurality of unit cells are arranged in two-dimension. Each of the unit cells indicates one of at least three colors, such as, "white", "black", "red", "blue", and "green". Each color of each of the unit cells is optically readable and represents a data value set to each of the unit cells. In the two-dimensional code, a specifying pattern portion is provided. The specifying pattern portion includes a plurality of color reference cells and is configured to specify positions of the unit cells. The color reference cells indicates all of the at least three colors.

[0007] In a matrix code sheet described in JP10283446, against which the claims are delimited, a quadrilateral display area is divided into a second dimensional direction, and 2N (N

is more than 3) pieces of unit data areas are arranged like a matrix. A classification of data recording marks to be recorded in each data unit area is M (M is more than 3) kinds whose hue is different, and hue reference displays for displaying the M kinds of hue samples of the data recording marks K are formed.

[0008] US 2008/0000991 A1 discloses a bar code encoding system and a bar code decoding system. The bar code encoding system includes a method for compressing the original data and adding data for error detection and correction to the compressed data to generate a large capacity 2-dimensional color bar code so as to be used as prints in an offline environment and a large capacity 2-dimensional bar code pattern. The decoding system includes a method for receiving the prints including the 2-dimensional bar code generated by the encoding system through an input device such as a scanner and a camera, searching the 2-dimensional bar code to recognize it, performing color correction and error detection and correction, decompressing the compressed data to decode the original data.

[0009] US 2011 0290882 discloses a generic QR code.

[0010] A two-dimensional bar code with a border including timing cells is known from US 4,924,078.

[0011] There is therefore a need of an improved color barcode which is durable and enables reliable decoding of information.

BRIEF DESCRIPTION OF THE FIGURE

[0012] The accompanying figure together with the detailed description below forms part of the specification and serves to further illustrate various embodiments and to explain various principles and advantages all in accordance with the present invention.

FIG. 1A illustrates architecture of a multidimensional color barcode in accordance with an embodiment of the invention.

FIG. 1B illustrates a method of placing palette cells in color palettes in the multidimensional color barcode in accordance with various embodiments of the invention.

FIG. 2 illustrates a flow diagram for a method of encoding information in multidimensional color barcode in accordance with various embodiments of the invention.

FIG. 3 illustrates a flow diagram for a method of decoding information in multidimensional color barcode in accordance with various embodiments of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0013] The invention is defined by the independent claims.

[0014] Preferred embodiments are set out in the dependent claims.

[0015] Before describing in detail embodiments that are in accordance with the invention, it should be observed that the embodiments reside primarily in method steps related to generating a multidimensional color barcode. Accordingly, the method steps have been represented where appropriate by conventional symbols in the drawings, showing only those specific details that are pertinent to understanding the embodiments of the invention so as not to unnecessarily obscure the disclosure with details that will be readily apparent to those of ordinary skill in the art having the benefit of the description herein.

[0016] Generally speaking, pursuant to various embodiments, the invention provides an architecture of a multidimensional color barcode. The multidimensional color barcode includes a plurality of data cells for encoding information and a plurality of palette cells that form a color palette. The plurality of palette cells are arranged in a predefined order in the color palette. A palette cell is assigned with a palette value based on the predefined order of the plurality of palette cells. Further, the plurality of palette cells are placed on each side of the multidimensional color barcode according to the predefined order. The information is encoded/decoded using colors associated with the plurality of data cells of the multidimensional color barcode by referring to the color palette and the predefined order of the plurality of palette cells in the color palette.

[0017] FIG. 1A illustrates architecture of a multidimensional color barcode 100 in accordance with an embodiment of the invention. As illustrated, multidimensional color barcode 100 includes plurality of data cells 102-n and plurality of palette cells 104-n. As shown, multidimensional color barcode 100 also includes alternating black and white tic marks 106. Multidimensional color barcode 100 can be for example, but not limited to, a three dimensional color barcode and a four dimensional color barcode.

[0018] In accordance with various embodiments of the invention, plurality of data cells 102-n are encoded with information. Each data cell of plurality of data cells 102-n is assigned with a color based on the information encoded in a data cell. For example, a data cell 102-1, a data cell 102-2 and a data cell 102-3 are encoded with information using a palette cell 104-1, a palette cell 104-3 and a palette cell 104-3, respectively, selected from plurality of palette cells 104-n.

[0019] Further, as shown in FIG. 1A, plurality of palette cells 104-n form a color palette. Plurality of palette cells 104-n are arranged in a pre-defined order in the color palette. Accordingly, a palette cell of (such as palette cell 104-1) is assigned with a palette value. This way, the color palette may be considered as an index of colors, wherein each color is referenced using a corresponding palette value. In an embodiment, the color palette is placed

along the periphery (sides) of multidimensional color barcode 100. Plurality of palette cells 104-n of the color palette are repeated and placed on each side of multidimensional color barcode 100. Thus, if a palette cell is damaged, a decoder may obtain reference colors from another palette cell of another color palette which is placed along the periphery of multidimensional color barcode 100. This is further explained in conjunction with description of FIG. 1B.

[0020] In accordance with various embodiments, plurality of data cells 102-n are encoded with information corresponding to two or more two dimensional barcodes. Accordingly, if the information encoded in data cell 102-1 corresponds to a two or more digits binary number, then each digit of the binary number depicts a value for a corresponding cell in a two dimensional barcode. For example, if data cell 102-1 stores 010 (binary number), then then 0 represents a corresponding data cell on a first two dimensional barcode, 1 represents corresponding data cell on a second two dimensional barcode and 0 represents corresponding data cell on a third two dimensional barcode.

[0021] Similarly, a data cell is associated with a color based on a binary number encoded in the data cell. A decimal number corresponding to the binary number is used to derive a palette value. Thereafter, the palette value is used to pick a corresponding palette cell from the color palette. Subsequently, the data cell is associated with the corresponding color. The method of encoding of information in multidimensional color barcode 100 is explained in further detail in conjunction with description of FIG. 2.

[0022] In accordance with various embodiments, data from plurality of data cells 102-n is read using a data decoding device such as a scanner. The scanner reads-out a color assigned to each data cell of plurality of data cells 102-n. Thereafter, colors obtained from the read-out are matched with corresponding reference colors included in the color palette. Subsequently, palette values associated with the colors is used to obtain binary number associated with each data cell of multidimensional color barcode 100. Decoding process is explained in further detail in conjunction with description of FIG. 3.

[0023] FIG. 1B illustrates a method of placing plurality of palette cells 104-n in the color palette in multidimensional color barcode 100 in accordance with various embodiments of the invention. In an embodiment, plurality of palette cells 104-n are placed repeatedly on each side of multidimensional color barcode 100. As explained earlier, plurality of palette cells 104-n are placed in a predefined order in the color palette. In an exemplary embodiment, a color palette includes seven different palette cells, wherein the colors are placed in a predefined order such that color of first palette cell is yellow and color of last palette cell is black. The predefined order of placing palette cells in a color palette is repeated for each color palette. Each color palette is placed along the periphery of multidimensional color barcode 100. Consecutive color palettes are placed next to each other repeatedly along the periphery of multidimensional color barcode 100 by keeping a gap of one cell in multidimensional color barcode 100. In the present embodiment shown in Fig. 1B, the palette cell 104-1 is black, 104-2 is magenta, 104-3 is orange, 104-4 is grey, 104-5 is beige, 104-6 is green, 104-7 is yellow.

[0024] In an embodiment, in vertical direction of multidimensional color barcode 100, plurality of palette cells 104-n in the color palette are placed from bottom up whereas in horizontal direction of multidimensional color barcode 100 plurality of palette cells 104-n in the color palette are placed from right to left. This assists a data decoding device to match color of a data cell with a reference color. In a scenario, if the data decoding device is not able to detect a first reference color placed on a color palette on the horizontal side of multidimensional color barcode 100 because of insufficient light, then the data decoding device can obtain the reference color by checking another color palette placed on the vertical side of multidimensional color barcode 100.

[0025] Such placement improves redundancy in multidimensional color barcode 100, thereby improving reliability and durability of multidimensional color barcode 100. For example, even if one side of multidimensional color barcode 100 is degraded due to any reason, other sides may be used to refer one or more colors in the color palette for the purpose of decoding the information.

[0026] Moving on to FIG. 2 which illustrates a flow diagram for a method of encoding information in multidimensional color barcode 100 in accordance with various embodiments of the invention. At step 202, information to be encoded in multidimensional color barcode 100 is split equally into three or more subsets. This forms layers for encoding information in multidimensional color barcode 100. The layer design for multidimensional color barcode 100 makes it stable for encoding. Subsequently, a two dimensional barcode is generated for each subset of the three or more subsets of information at step 204. Accordingly, several two dimensional barcodes are generated and each two dimensional barcode is equal in size. In an embodiment, a two dimensional barcode is one of, but not limited to, black and white barcode, datamatrix or a Quick Response (QR) code.

[0027] Once the three or more two dimensional barcodes are generated, at step 206, the three or more two dimensional barcodes are combined to obtain a binary number corresponding to each data cell of multidimensional color barcode 100. Each digit of a binary number depicts a value of a data cell of each of the three or more two dimensional barcodes. For example, if the binary number is 111, then a first digit, 1, represents a corresponding data cell on a first two dimensional barcode, a second digit, 1, represents corresponding data cell on a second two dimensional barcode and a third digit, 1, represents corresponding data cell on a third two dimensional barcode.

[0028] Moving on, a binary number associated with a data cell is converted to a corresponding decimal number. A decimal number is considered as a palette value and accordingly, the color palette is referred to, in order to determine a corresponding color with the palette value. Subsequently, a color is assigned to each data cell of multidimensional color barcode 100 at step 208.

[0029] FIG. 3 illustrates a flow diagram for a method of decoding information in multidimensional color barcode 100 in accordance with various embodiments of the invention.

At step 302, colors from plurality of data cells 102-n of multidimensional color barcode 100 are extracted using an information decoding device. In an embodiment, the information decoding device is one of, but not limited to, a scanner and an image capturing device. In an embodiment, the information decoding device captures a binarized version of multidimensional color barcode 100 to obtain a temporary black and white code of multidimensional color barcode 100. The temporary black and white code is used to obtain L-shape side of multidimensional color barcode 100 and alternating black and white tic marks 106. The L-shape side of multidimensional color barcode 100 and alternating black and white tic marks 106 assist in extracting colors from plurality of data cells 102-n of multidimensional color barcode 100.

[0030] Moving on, a color which is extracted is matched with a reference color in a color palette. As explained earlier, plurality of palette cells 104-n are arranged in a predefined order in the color palette. Further, each palette cell is associated with a palette value based on its position in the predefined order. Extracted color is matched with a reference color in the color palette which is closest to the extracted color. This assists the data decoding device in identifying the reference color, since the reference color has same lighting strength and intensity as color of the data cell. In a scenario, if the reference color in a particular color palette is damaged, then corresponding reference color is referenced from other color palettes placed on other sides of multidimensional color barcode 100. For example, if a red color is extracted from a data cell of multidimensional color barcode 100, then the red color is matched with corresponding reference red color from a color palette which is closest to the data cell. If the corresponding reference red color is damaged, then reference red color from another color palette is chosen. This process continues until a reference red color is obtained which has same lighting strength and intensity as color of the data cell.

[0031] Thereafter, at step 304, a palette value corresponding to the color is determined based on its position in the predefined order. At step 306, binary number corresponding to the palette value is derived wherein each digit of the binary number depicts a value for a corresponding data cell in a two dimensional barcode of three or more two dimensional barcodes. For example, if a color associated with a data cell is red, and a position of the red color is 5 in the color palette, then a palette value for the color red is 5. Accordingly, binary number corresponding to decimal number 5 is 101. Therefore, the data cell was encoded with the information corresponding to the binary number 101. In accordance with the embodiment of the invention, each of the digits of the binary number corresponds to a value a corresponding data cell of a two dimensional barcode. For example, for the binary number 101, the first digit 1 indicates value of a data cell of a first two dimensional barcode, the second digit 0 represents corresponding data cell of a second two dimensional barcode and the third digit 1 represents corresponding data cell in a third two dimensional barcode. This assists in obtaining values of data cells of each of the three or more two dimensional barcodes. Subsequently, at step 308, output data corresponding to each of the three or more two dimensional barcodes is obtained. Thereafter, at step 310, output data corresponding to each of the three or more two dimensional barcodes are combined to retrieve the information encoded in multidimensional color barcode 100

[0032] Various embodiments of the invention disclosed herein provide a multidimensional color barcode with improved durability and reliability. In accordance with an embodiment of the invention one or more color palettes are repeatedly placed on each side of the multidimensional color barcode for assisting reliable decoding of information in case one or more color palettes gets degraded over a period of time.

[0033] Those skilled in the art will realize that the above recognized advantages and other advantages described herein are merely exemplary and are not meant to be a complete rendering of all of the advantages of the various embodiments of the present invention.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US20040182930A1 **[0006]**
- JP10283446B **[0007]**
- US20080000991A1 **[0008]**
- US20110290882A **[0009]**
- US4924078A **[0010]**

Patentkrav

1. Flerdimensional farvestregkode (100) til lagring af information, hvilken flerdimensionale farvestregkode (100) omfatter:

et antal dataceller (102), hvorved i det mindste en datacelle ud af antallet af dataceller (102) er kodet med information, og
et antal paletceller (104), hvorved antallet af paletceller (104) danner en farvepalet, hvorved der på hver side af den flerdimensionale farvestregkode er placeret en farvepalet,
hvorved antallet af paletceller (104) er anbragt i en forudbestemt rækkefølge i farvepaletten, hvorved en paletcelle (104) er tildelt en paletværdi baseret på en forudbestemt rækkefølge af antallet af paletceller (104),
hvorved en datacelle (102) er tildelt en farve valgt fra farvepaletten,
hvorved en datacelle (102) er tilknyttet et binært tal, hvorved det binære tal er afledt fra en paletværdi, som er tilknyttet datacellens (102) farve,
kendetegnet ved, at hvert ciffer i det binære tal fremstiller en værdi for en tilsvarende datacelle i en todimensional stregkode ud af i det mindste tre todimensionale stregkoder, hvorved de i de mindste tre todimensionale stregkoder er genereret af i det mindste tre tilsvarende delsæt opnået fra spaltning af den information, der skal lagres.

2. Flerdimensional farvestregkode (100) ifølge krav 1, og som yderligere omfatter alternerende sorte og hvide tic-mærker på to sider af den flerdimensionale farvestregkode.

3. Flerdimensional farvestregkode (100) ifølge krav 1 eller 2, hvorved den todimensionale stregkode er en ud af en sort og hvid stregkode, en datamatrix og en QR-kode.

4. Fremgangsmåde til kodning af information i en flerdimensional farvestregkode (100), hvorved den flerdimensionale farvestregkode (100)

omfatter et antal dataceller (102) og en farvepalet placeret på hver side af den flerdimensionale farvestregkode (100), hvorved farvepaletten omfatter et antal farveceller (104), hvilken fremgangsmåde omfatter:

spaltning af den information, der skal kodes i i det mindste tre delsæt (202),
generering af en todimensional stregkode for hver af de i det mindste tre delsæt (204),
kombinering af de i det mindste tre todimensionale stregkoder til opnåelse af et binært tal svarende til en datacelle (102) i den flerdimensionale farvestregkode (100) (206), hvorved en datacelles værdi i hver af de i det mindste tre todimensionale stregkoder fremstiller et ciffer i det binære tal, og
tildeling af en farve til datacellen (102) baseret på det binære tal, som er tilknyttet datacellen (102), hvorved farven opnås fra farvepaletten (208).

5. Fremgangsmåde ifølge krav 4, hvorved antallet af paletceller (104) er anbragt i en forudbestemt rækkefølge, hvorved en paletcelle (104) tildeles en paletværdi baseret på den forudbestemte rækkefølge af antallet af paletceller (104).

6. Fremgangsmåde ifølge krav 5, hvorved et binært tal, som er tilknyttet en datacelle (102) konverteres til et decimaltal, hvorved decimaltallet svarer til en paletværdi for paletcellen (104) i farvepaletten.

7. Fremgangsmåde ifølge et af de foregående krav 4 til 6, hvorved en todimensional stregkode er en ud af en sort og hvid stregkode, en datamatrix og en QR-kode.

8. Fremgangsmåde til dekodning af information fra en flerdimensional farvestregkode (100), hvorved informationen er blevet kodet ved hjælp af en fremgangsmåde ifølge krav 4, hvorved den flerdimensionale farvestregkode (100) omfatter et antal dataceller (102) og en farvepalet, som er placeret på hver side af den flerdimensionale farvestregkode (100), hvorved farvepaletten omfatter et antal paletceller (104), hvilken fremgangsmåde omfatter:

udtrækning af en farve fra en datacelle (102) i den flerdimensionale farvestregkode (100) (302),

bestemmelse af en paletværdi svarende til farven baseret på en forudbestemt rækkefølge af antallet af paletceller (104) i farvepaletten (304),

udledning af en binær værdi svarende til paletværdien, hvorved hvert ciffer i den binære værdi fremstiller en værdi for en tilsvarende datacelle i en todimensional stregkode ud af i det mindste tre todimensionale stregkoder (306),

opnåelse af outputdata svarende til hver todimensional stregkode i de i det mindste tre todimensionale stregkoder (308) og

genforening af outputdataene svarende til hver todimensional stregkode i de i det mindste tre todimensionale stregkoder (310).

9. Fremgangsmåde ifølge krav 8, hvorved en todimensional stregkode er en ud af en sort og hvid stregkode, en datamatrix og en QR-kode.

DRAWINGS

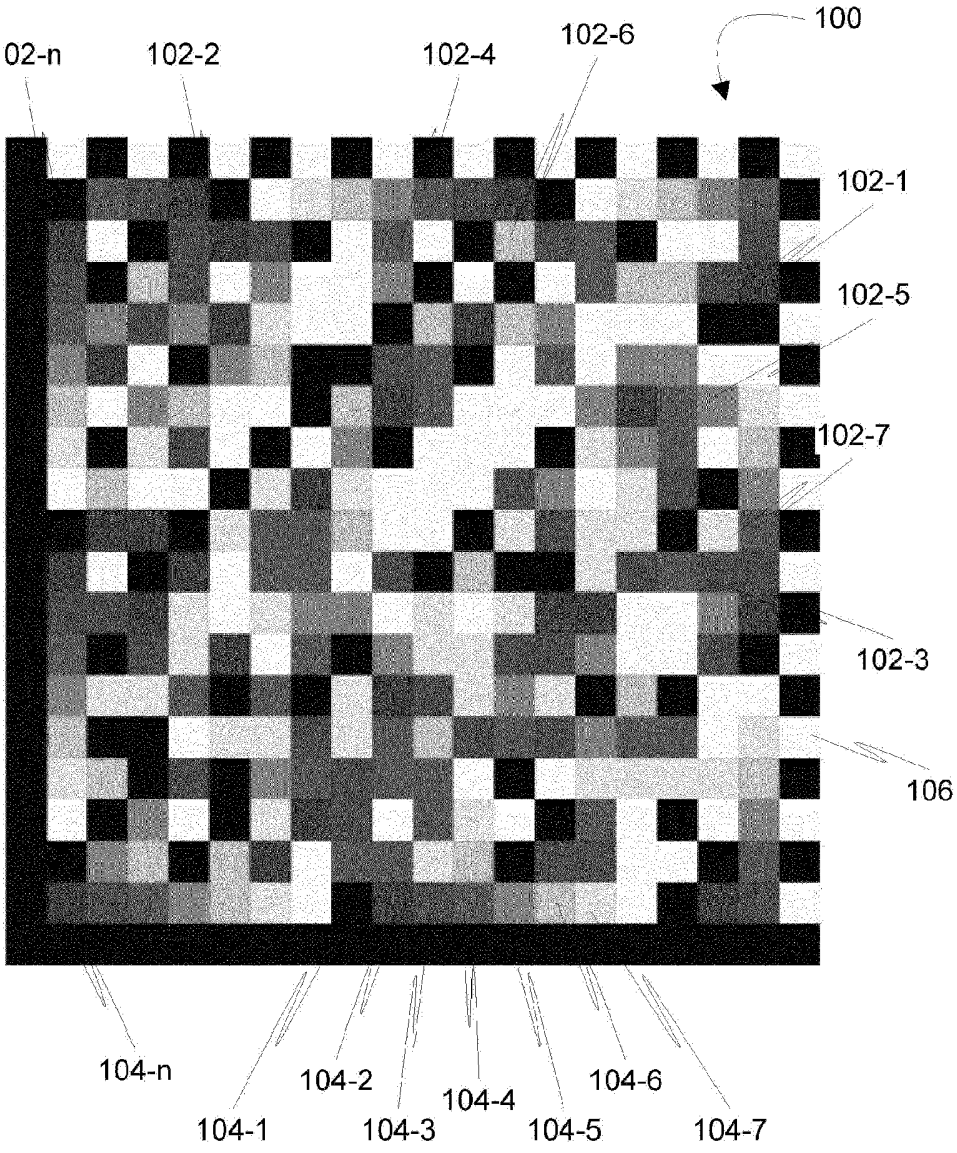

FIG. 1A

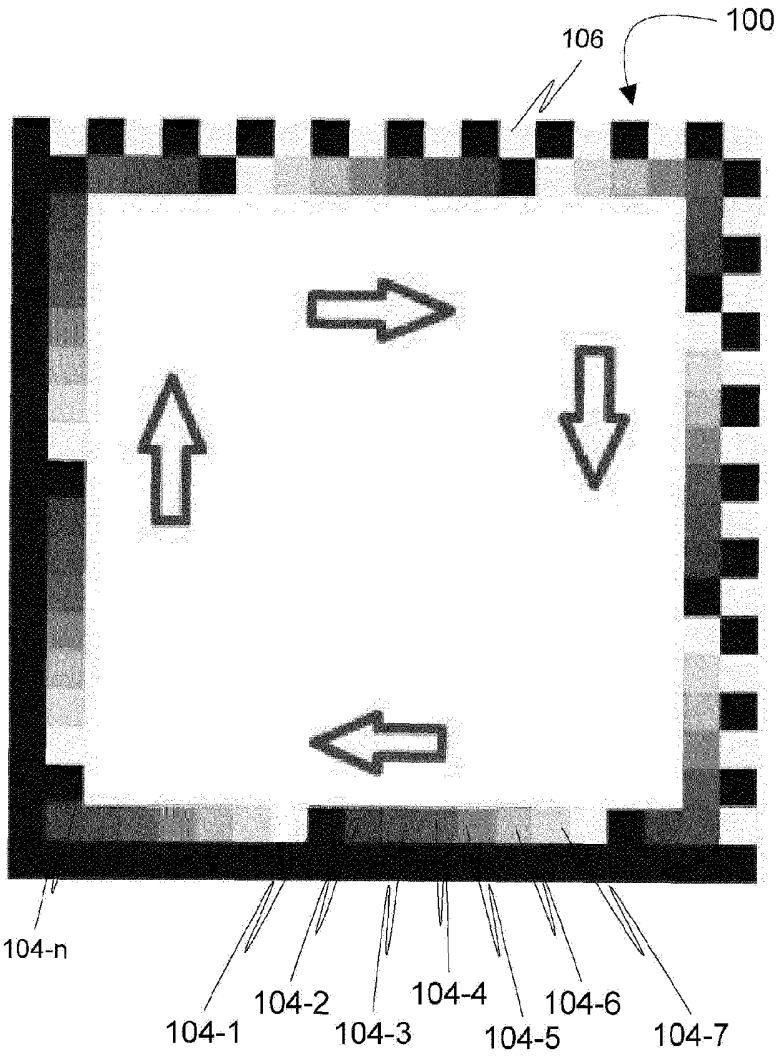

FIG. 1B

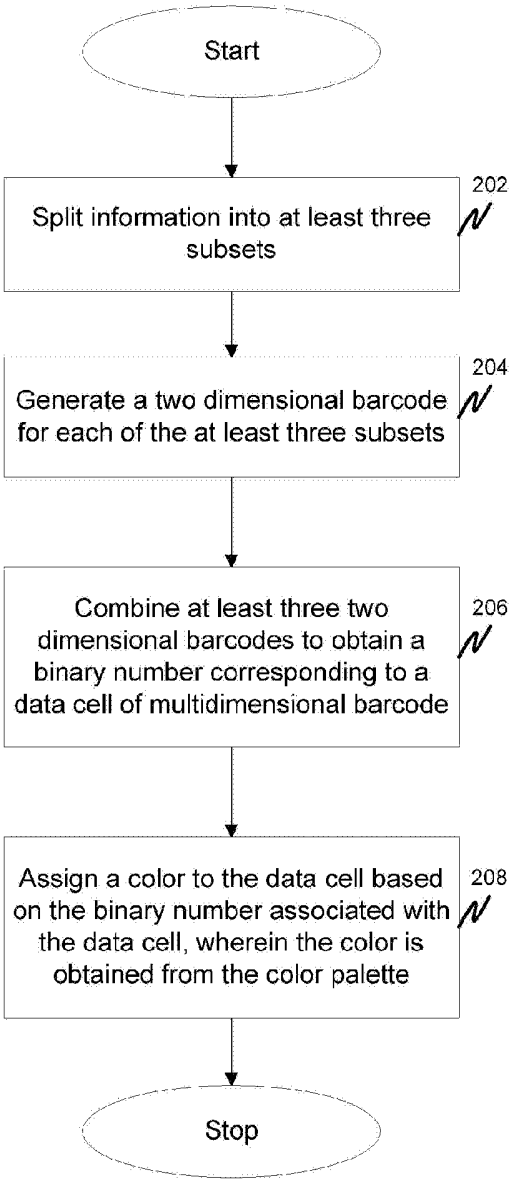
Start
Split information into at least three subsets
202
Generate a two dimensional barcode for each of the at least three subsets
204
Combine at least three two dimensional barcodes to obtain a binary number corresponding to a data cell of multidimensional barcode
206
Assign a color to the data cell based on the binary number associated with the data cell, wherein the color is obtained from the color palette
208
Stop

FIG. 2

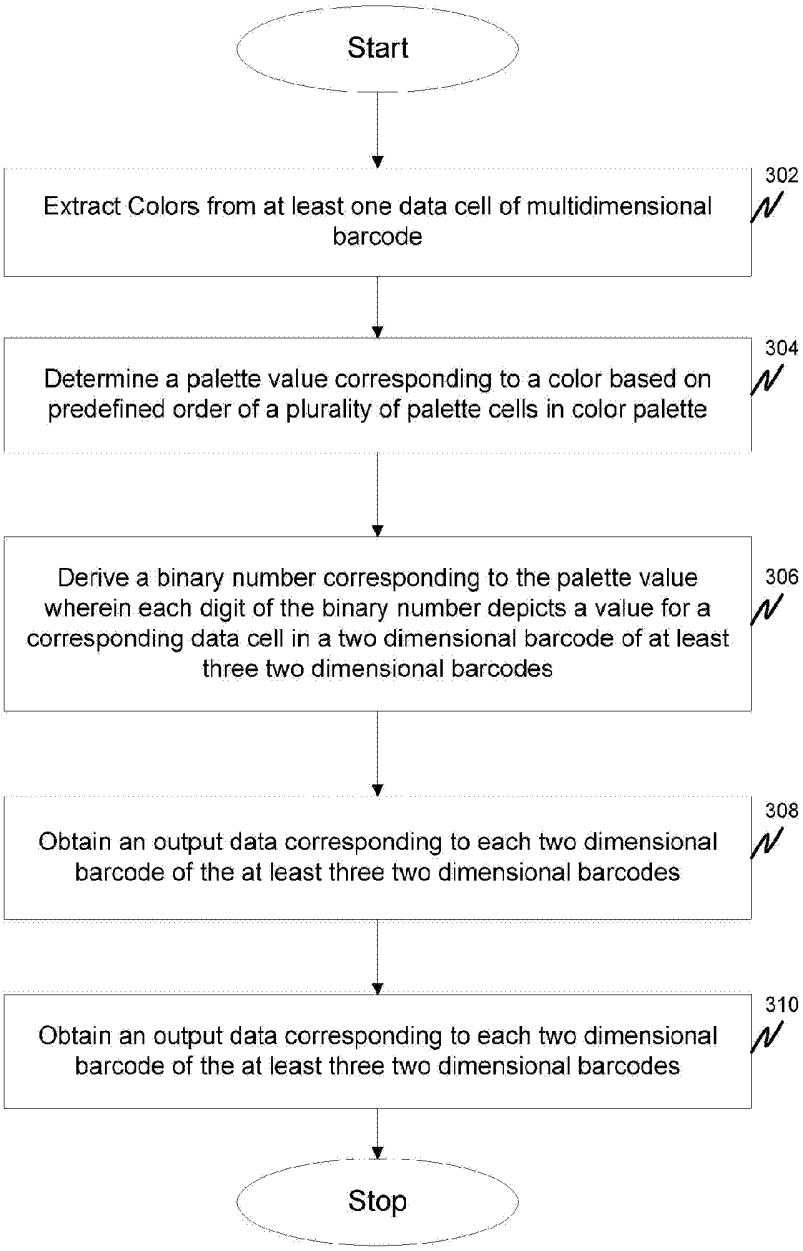
Start
Extract Colors from at least one data cell of multidimensional barcode
302
Determine a palette value corresponding to a color based on predefined order of a plurality of palette cells in color palette
304
Derive a binary number corresponding to the palette value wherein each digit of the binary number depicts a value for a corresponding data cell in a two dimensional barcode of at least three two dimensional barcodes
306
Obtain an output data corresponding to each two dimensional barcode of the at least three two dimensional barcodes
308
Obtain an output data corresponding to each two dimensional barcode of the at least three two dimensional barcodes
310
Stop

FIG. 3