

Claims

1. A two-dimensional dot matrix barcode encoding method, wherein a two-dimensional dot matrix barcode is composed of $M \times N$ virtual code point storage blocks, and a plurality of coordinate calibration blocks, a plurality of data storage blocks, a first indication block and a second indication block are formed respectively by filling code points into the virtual code point storage blocks, wherein

code points filled in the plurality of coordinate calibration blocks are located in the center of the virtual code point storage block;

a code point filled in the first indication block is located in the center thereof, and the second indication block is not filled with a code point or is filled, in the center thereof, with an ink code point capable of reflecting a light having a specific wavelength;

a direction and coordinate indication set indicative of a direction and a coordinate is formed by means of a combination of the first indication block and the second indication block;

the plurality of coordinate calibration blocks are separated from each other and distributed among the two-dimensional dot matrix barcode;

code points filled in the plurality of data storage blocks are used to store data information, and the code points filled in the plurality of data storage blocks are disposed away from the center of the virtual code point storage block; and

the plurality of coordinate calibration blocks and the plurality of data storage blocks have only one code point,

where $M \geq 4$, $N \geq 4$, and M and N are both even numbers.

2. The two-dimensional dot matrix barcode encoding method of claim 1, wherein in the two-dimensional dot matrix barcode, the virtual code point storage blocks in which row coordinates and column coordinates are both odd or even are coordinate calibration blocks, and the remaining virtual code point storage blocks are the first indication block, the second indication block and the data storage blocks.

3. The two-dimensional dot matrix barcode encoding method of claim 1, wherein

the plurality of coordinate calibration blocks, the plurality of data storage blocks, a first indication block and a second indication block are divided into 3×3 sub-blocks by

virtual row and column lines respectively, and a central sub-block of each coordinate calibration block is filled with a code point;

a central sub-block of the first indication block is filled with a code point;

the second indication block is not filled with a code point or a central sub-block is filled with an ink code point capable of reflecting a light having a specific wavelength; and

only one sub-block in each of the data storage blocks is filled with code points, a middle sub-block of the data storage block is not provided with a code point, and the data storage block stores different data by filling code points in different sub-blocks.

4. The two-dimensional dot matrix barcode encoding method of claim 1, wherein after the direction and coordinate indication set is rotated by $\pm 90^\circ$ or 180° around the geometric center of the second indication block, the first indication block does not overlap with that before rotation.

5. A two-dimensional dot matrix barcode identifying method, used for identifying a two-dimensional dot matrix barcode obtained by the two-dimensional dot matrix barcode encoding method according to any one of claim 1, the two-dimensional dot matrix barcode reading method comprising the following steps:

acquiring a code map grayscale image not smaller than the size of a two-dimensional dot matrix barcode, the grayscale image comprising at least one direction and coordinate indication set and a plurality of coordinate calibration blocks;

acquiring row and column positions of the coordinate calibration blocks and the direction and coordinate indication set in the two-dimensional dot matrix barcode according to the grayscale image comprising the at least one direction and coordinate indication set and the plurality of coordinate calibration blocks; and reading data stored in the two-dimensional dot matrix barcode according to the grayscale image and the row and column positions of the coordinate calibration blocks and the direction and coordinate indication set.

6. The two-dimensional dot matrix barcode identifying method of claim 5, wherein reading data stored in the two-dimensional dot matrix barcode comprises the following steps:

S1: performing binarization processing on the grayscale image to obtain a binary image, and marking a code point in the binary image to determine a barycentric coordinate (x, y) of the code point;

S2: determining a row direction and a column direction of the code point and a row dividing point and a column dividing point: determining a row direction and a column direction of the code point by taking the geometric center of the binary image as a rotation center and calculating a mean square error of a projection waveform of the barycentric coordinate of the code point in a predetermined direction at each rotation angle of the binary image, then projecting the barycentric coordinate (x, y) of the code point in the row direction and the column direction, and calculating row dividing points and the column dividing points for the projection waveform by using an autocorrelation method;

S3: rotating and converting the barycentric coordinate (x, y) of the code point according to the row direction and the column direction obtained in step S2, calculating a converted code point coordinate (x_1, y_1) after rotation, and forming, by using the row dividing point and the column dividing points obtained in step S2, a rectangular mesh for dividing the code point;

S4: constructing a two-dimensional matrix corresponding to the rectangular mesh obtained in step S3, determining, according to the converted code point coordinate (x_1, y_1) , a block in the rectangular mesh to which converted code point coordinate belongs, and then adding the converted code point coordinate (x_1, y_1) to a unit of the two-dimensional matrix corresponding to the block;

S5: identifying a rotation direction and an offset of the two-dimensional matrix according to the unit of the two-dimensional matrix in feature matching with the first indication block and the second indication block; and

S6: reconstructing a complete two-dimensional dot matrix barcode according to the rotation direction and the offset, and reading data stored therein.

7. The two-dimensional dot matrix barcode identifying method of claim 6, wherein the rotation direction of the two-dimensional matrix is obtained according to a relative position between the first indication block and the second indication block.

8. The two-dimensional dot matrix barcode identifying method of claim 6, wherein the step of reading values stored in the data storage block according to the coordinate calibration block specifically comprises: first, calculating a center coordinate of the data storage block according to a converted code point coordinate (x_1, y_1) of the coordinate calibration block; and then, reading the stored data according to an offset of the converted code point coordinate (x_1, y_1) of the code point stored in the data storage block relative to the center coordinate.

9. The two-dimensional dot matrix barcode identifying method of claim 8, wherein the center coordinate of the data storage block is calculated by using an interpolation method according to the converted code point coordinate (x_1 , y_1) of the coordinate calibration block.

10. The two-dimensional dot matrix barcode identifying method of claim 6, wherein the step of reconstructing a complete two-dimensional dot matrix barcode comprises the following sub-steps:

S601: acquiring correct reference positions of the second indication block, the coordinate calibration block and the data storage block respectively;

S602: identifying units in feature matching with the second indication block, the coordinate calibration block and the data storage block in the two-dimensional matrix respectively, and determining relative positions of the units in feature matching with the coordinate calibration block and the data storage block by taking the unit in feature matching with the second indication block as a position origin;

S603: allowing the position origin to overlap with the correct reference position of the second indication block, and allowing the relative position of the unit in feature matching with the coordinate calibration block of the two-dimensional matrix to overlap with the correct reference position of the coordinate calibration block; and

S604: decomposing the virtual code point storage blocks in the two-dimensional matrix with reference to the correct reference positions, and moving them to correct positions, so as to reconstruct a two-dimensional matrix that is the same as the two-dimensional dot matrix barcode in both row-column number and arrangement.