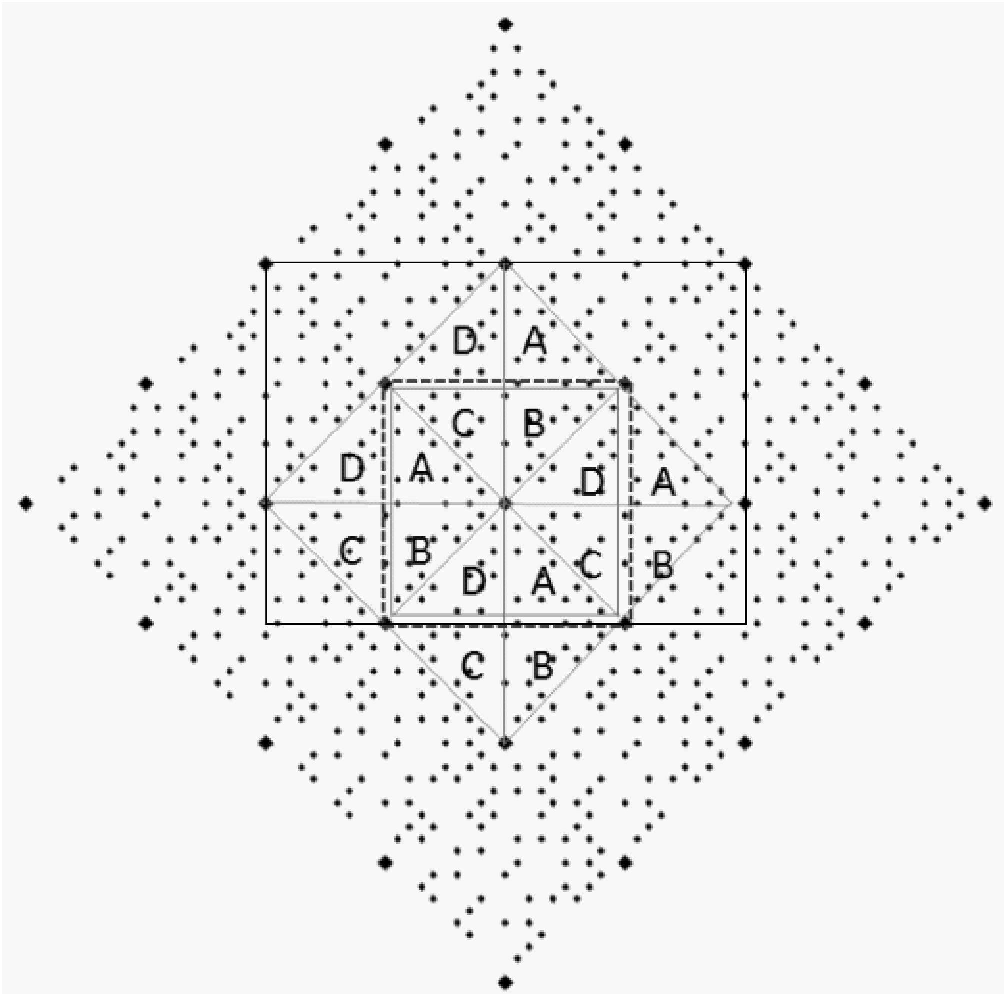

FIG. 1

We Claim:-

1. A decoding method for a matrix two-dimensional code, wherein: a matrix two-dimensional code image to be decoded is a code array of jointed matrix two-dimensional code symbols, formed by multiple identical unit code patterns; an image obtained by scanning does not need to comprise a complete unit code pattern, and a decoding process of the image is: obtaining a binary image of a to-be-decoded code array of jointed matrix two-dimensional code symbols, locating each code point and positioning point in a unit code pattern that the code point and the positioning point belong to, so as to restore a complete unit code pattern, and then performing decoding.

2. The decoding method for a matrix two-dimensional code according to claim 1, wherein, the locating each code point and positioning point in a unit code pattern that the code point and the positioning point belong to refers to assigning coordinate valuesto each code point and positioning point, wherein each code point and positioning point determined by the coordinate valueshave a same relative location relationship as each code point and positioning point in the image obtained by scanning.

3. The decoding method for a matrix two-dimensional code according to claim 2, wherein the assigning coordinate values to each code point and positioning point comprises the following steps:

separatelydetermining directions of a row line and a column line where each code point is located, wherein the determined directions are referred as a row direction and a column direction;

separatelydetermining a point spacing in the row direction and a point spacing in the column direction; and

calibrating row coordinates of each code point and positioning point by using the point spacing in the row direction and a projection waveform in the row direction, and calibrating column coordinates of each code point and positioning point by using the point spacing in the column direction and a projection waveform in the column direction.

4. The decoding method for a matrix two-dimensional code according to claim 2, wherein the assigning coordinate values to each code point and positioning point comprises the following steps:

determining a row direction and a column direction in the image;

separatelydrawing a group of parallel row lines and a group of parallel column lines according to the row direction and the column direction to form a grid, wherein distances between the parallel row lines and between the parallel column lines are the point spacing in a column line direction and the point spacing in a row line direction in the code pattern respectively; and

calculating coordinates of each cross point in the grid, so as to assign coordinate valuesto each code point and positioning point in the image.

5. The decoding method for a matrix two-dimensional code according to claim 3, wherein the determining a row direction and a column direction comprises the following steps:

A1. recognizing the binary image, so as to determine barycenters of each code point and positioning point;

A2. projecting the barycenter of each code point in the obtained image to any straight line L, calculating the number of projections at eachprojection point and an average value of the numbers of projections at allprojection points, and calculating a mean square error $\sigma 0$;

A3. rotating the obtained image by a predetermined angle θ, and calculating a mean square error $\sigma 1$ according to the method of Step A1;

A4. rotating the obtained image by a predetermined angle θ again, and calculating a mean square error $\sigma 2$ according to the method of Step A1; repeating the process until the image is rotated by a total of 180°, and calculating the last mean square error σn;

A5. drawing a line perpendicular to L at a position which is on the line L and has a maximum number of projections falling thereon in an image state corresponding to a maximum value of the mean square errors $\sigma 0$ to σn, wherein the drawn line is the row direction; and

A6. rotatingtheimage state corresponding to the row direction by ±(90°±21°), taking a maximum value of the mean square errors within this range, and drawing a line perpendicular to L at a position which is on the line L and has a maximum number of projection points falling thereon in an image state corresponding to the maximum value, wherein the drawn line is the column direction.

6. The decoding method for a matrix two-dimensional code according to claim 5, wherein the point spacing is determined by using a method of solving a discrete signal period by means of autocorrelation, which is specifically described as follows:

B1. translating each code point in the image state corresponding to the maximum value of the mean square error in Step A5 by m pixels along the row direction, and calculating an autocorrelation coefficient Z1 according to projection values of the barycenter of each code point before and after the translation; translating each code point in the obtained image by m+1 pixels, and calculating an autocorrelation coefficient Z2 according to projection values of the barycenters of each code point before and after the translation; translating each code point in the obtained image by m+2 pixels, and calculating an autocorrelation coefficient Z3 according to projection values of the barycenter of each code point before and after the translation; and continuing to translate the obtained image in this manner, until each code point in the obtained image is translated by m+n pixels, and calculating an autocorrelation coefficient Zn+1;

B2. taking a maximum value of Z1 to Zn+1, wherein a code point translation amount corresponding to the maximum value is the point spacing e in the row direction; and

B3. in a same way, translating each code point in the image state corresponding to the maximum value of the mean square errors in Step A6 for n' times along the column direction, and calculating a maximum autocorrelation coefficient, so as to obtain the point spacing f in the column direction;

wherein e and f are each the number of pixels, $m \geq 1$, m is a natural number, $m+n \approx e$, $m+n' \approx f$, and m+n and m+n' are each the number of pixels corresponding to a predicted point spacing.

7. The decoding method for a matrix two-dimensional code according to claim 5, wherein in the image rotation, a center point of the image is used as a rotation center.

8. The decoding method for a matrix two-dimensional code according to claim 4, wherein the parallel row lines and parallel column lines are determined by the following steps:

C1. separately calculating peak values of barycenter projections of code points in $a \cdot e \pm P$ areasalong the row direction, and drawing the parallel column lines according to the peak value in each area; and

C2. separately calculating peak values of barycenter projections of code points in $a \cdot f \pm P$ areasalong the column direction, and drawing the parallel row lines according to the peak value in each area;

wherein, P is a natural number not greater than the smaller one of e, f, and a is a natural number.

9. The decoding method for a matrix two-dimensional code according to claim 1, wherein

a method for restoring a complete unit code pattern is described as follows:

with a positioning point as a reference point, marking each code point according to a code structure feature of the two-dimensional code, and restoring a complete unit two-dimensional code according to the mark of each code point.

10. The decoding method for a matrix two-dimensional code according to claim 9, wherein the method for restoring a complete unit code pattern is described as follows:

with a positioning point as a reference point, marking in sequence code points at a right side or a left side of the positioning point as 0, 1, 2..., 9 cyclically; marking in sequence code points at a left side or a right side of the positioning point as 9, 8, 7..., 0 cyclically; marking in sequence code points at an upper side or a lower side of the positioning point as 0, 1, 2..., 9 cyclically; and marking in sequence code points at a lower side or an upper side of the positioning point as 9, 8, 7..., 0 cyclically; and

restoring a complete unit two-dimensional code according to the foregoing marks.

11. The decoding method for a matrix two-dimensional code according to claim 4, wherein the determining a row direction and a column direction comprises the following steps:

A1. recognizing the binary image, so as to determine barycenters of each code point and positioning point;

A2. projecting the barycenter of each code point in the obtained image to any straight line L, calculating the number of projections at each projection point and an average value of the numbers of projections at all projection points, and calculating a mean square error $\sigma 0$;

A3. rotating the obtained image by a predetermined angle θ, and calculating a mean square error $\sigma 1$ according to the method of Step A1;

A4. rotating the obtained image by a predetermined angle θ again, and calculating a mean square error $\sigma 2$ according to the method of Step A1; repeating the process until the image is rotated by a total of 180°, and calculating the last mean square error σn;

A5. drawing a line perpendicular to L at a position which is on the line L and has a maximum number of projections falling thereon in an image state corresponding to a maximum value of the mean square errors σ0 to σn, wherein the drawn line is the row direction; and

A6. rotating the image state corresponding to the row direction by ±(90°±21°), taking a maximum value of the mean square errors within this range, and drawing a line perpendicular to L at a position which is on the line L and has a maximum number of projection points falling thereon in an image state corresponding to the maximum value, wherein the drawn line is the column direction.

12. The decoding method for a matrix two-dimensional code according to claim 11, wherein the point spacing is determined by using a method of solving a discrete signal period by means of autocorrelation, which is specifically described as follows:

B1. translating each code point in the image state corresponding to the maximum value of the mean square error in Step A5 by m pixels along the row direction, and calculating an autocorrelation coefficient Z1 according to projection values of the barycenter of each code point before and after the translation; translating each code point in the obtained image by m+1 pixels, and calculating an autocorrelation coefficient Z2 according to projection values of the barycenters of each code point before and after the translation; translating each code point in the obtained image by m+2 pixels, and calculating an autocorrelation coefficient Z3 according to projection values of the barycenter of each code point before and after the translation; and continuing to translate the obtained image in this manner, until each code point in the obtained image is translated by m+n pixels, and calculating an autocorrelation coefficient Zn+1;

B2. taking a maximum value of Z1 to Zn+1, wherein a code point translation amount corresponding to the maximum value is the point spacing e in the row direction; and

B3. in a same way, translating each code point in the image state corresponding to the maximum value of the mean square errors in Step A6 for n' times along the column direction, and calculating a maximum autocorrelation coefficient, so as to obtain the point spacing f in the column direction;

wherein e and f are each the number of pixels, m≥1, m is a natural number, m+n≈e, m+n' ≈f, and m+n and m+n' are each the number of pixels corresponding to a predicted point spacing.

13. The decoding method for a matrix two-dimensional code according to claim 11,

wherein in the image rotation, a center point of the image is used as a rotation center.

Dated this 8th day of December 2014.

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Advocate & Patent Agent
For and on Behalf of Applicant

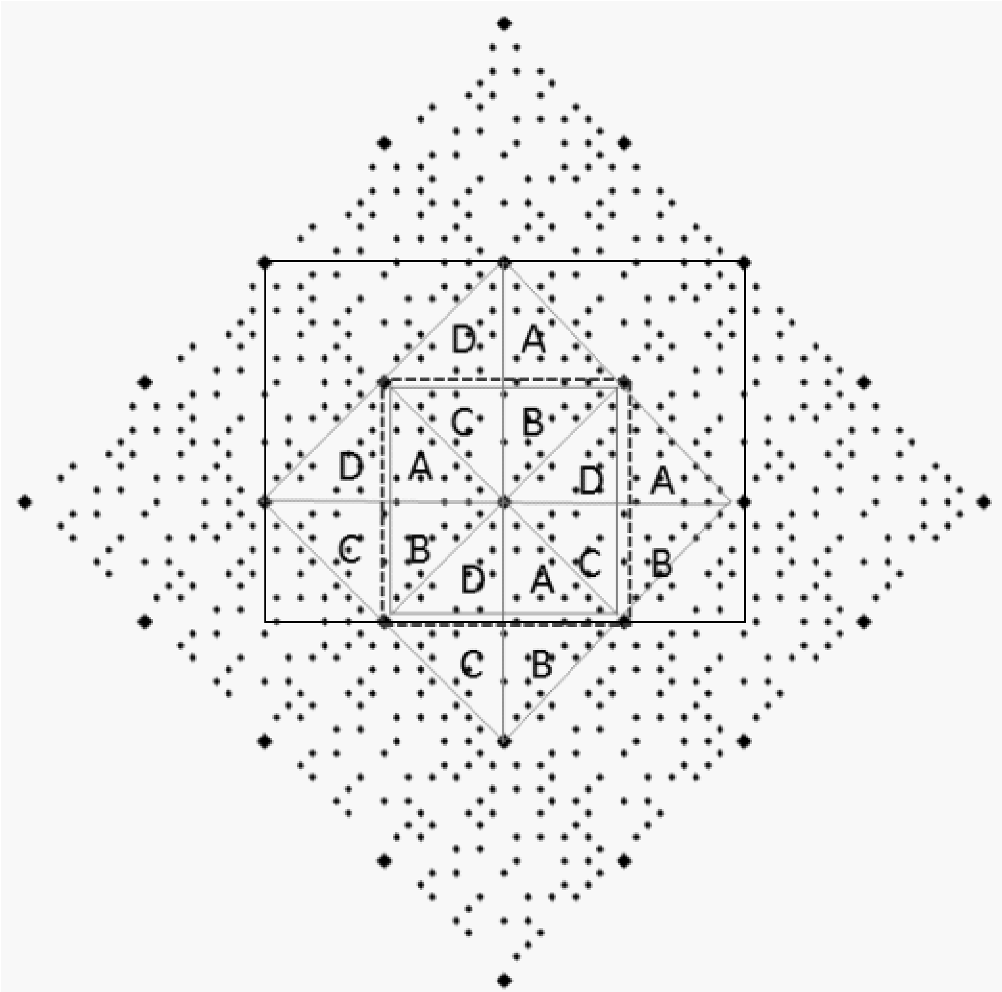

FIG. 1

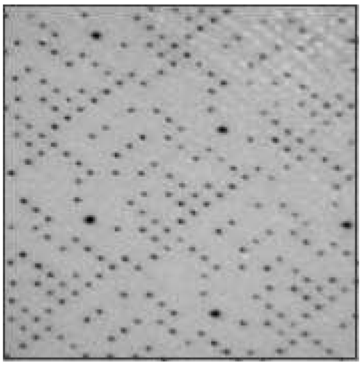

FIG. 2

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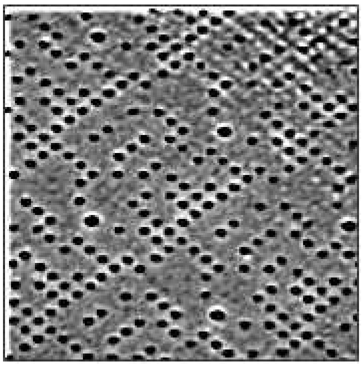

FIG. 3

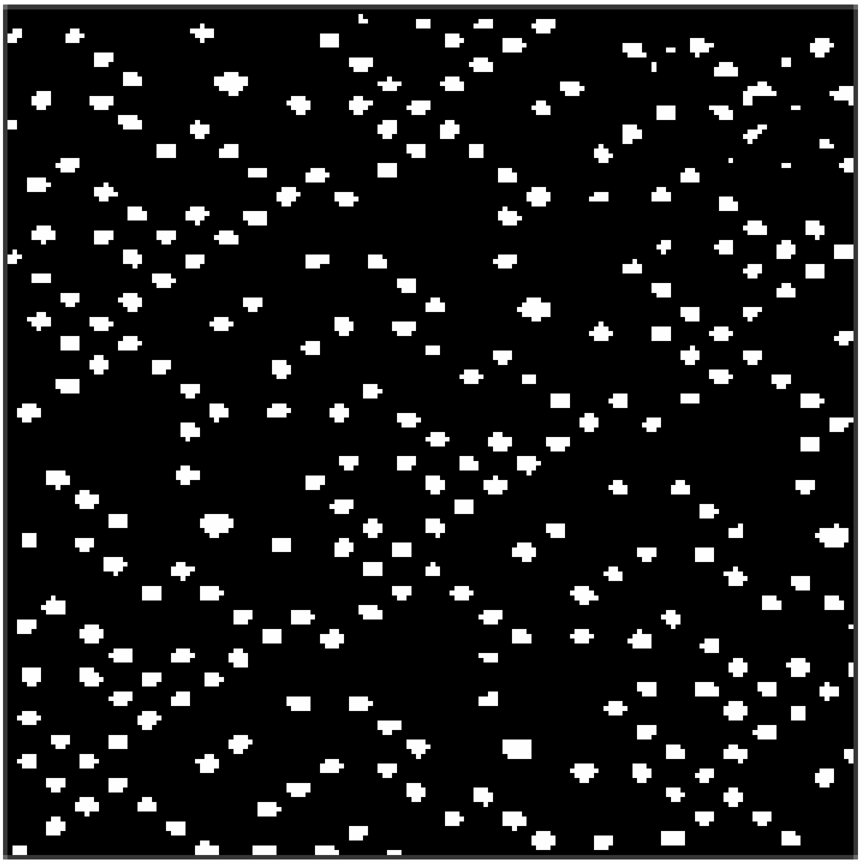

FIG. 4

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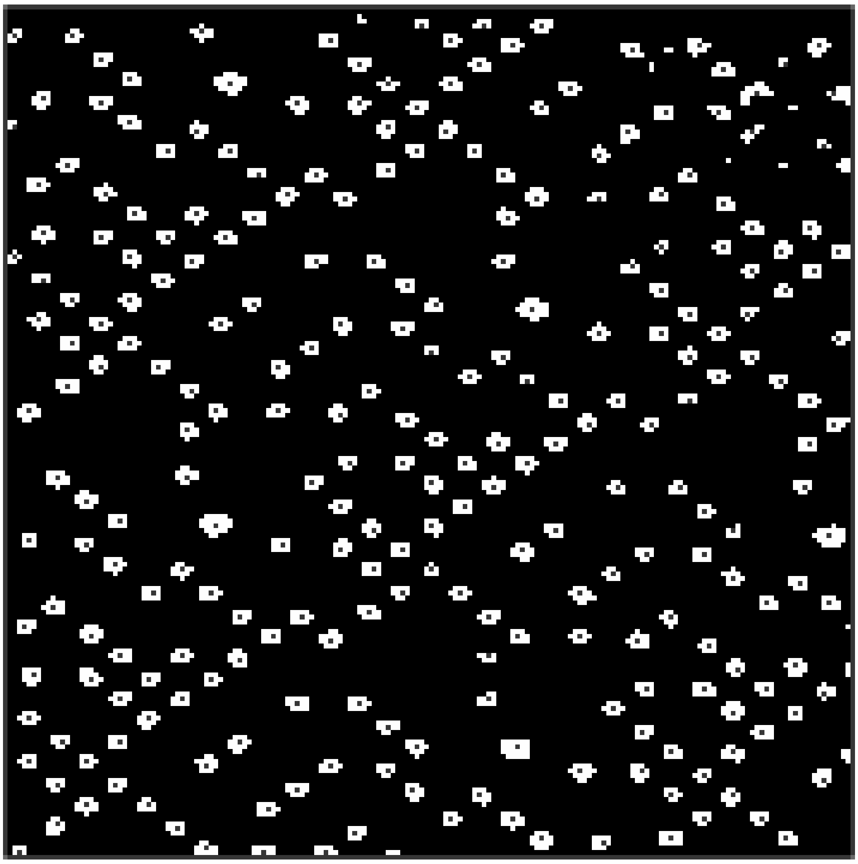

FIG. 5

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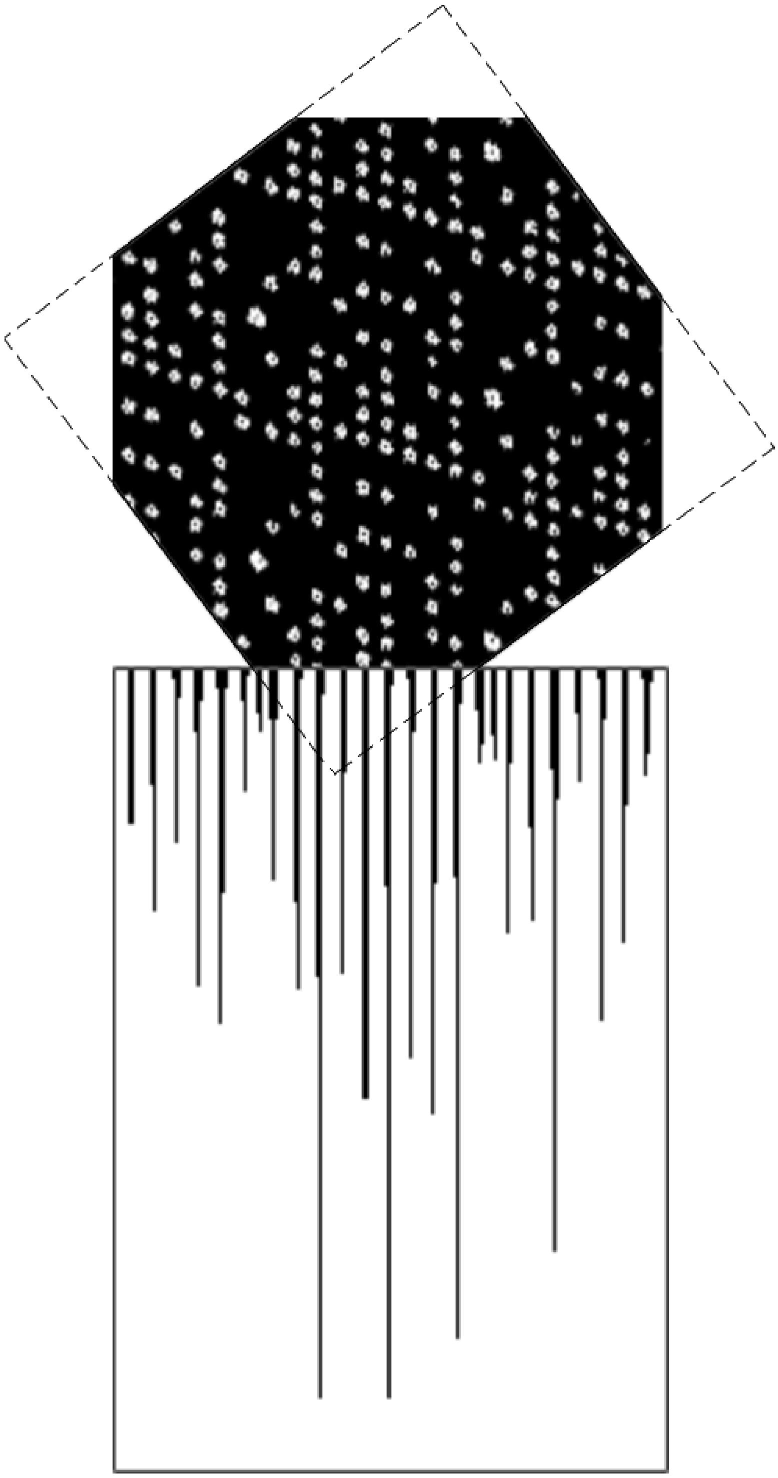

FIG. 6

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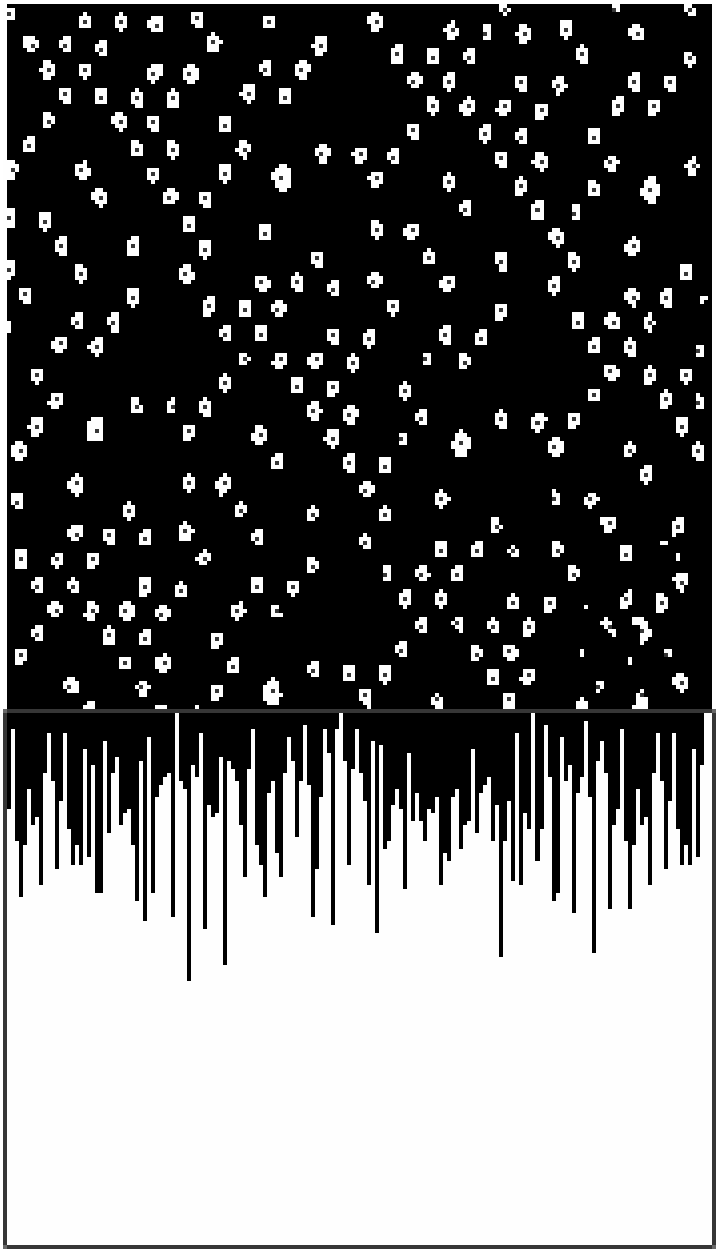

FIG. 7

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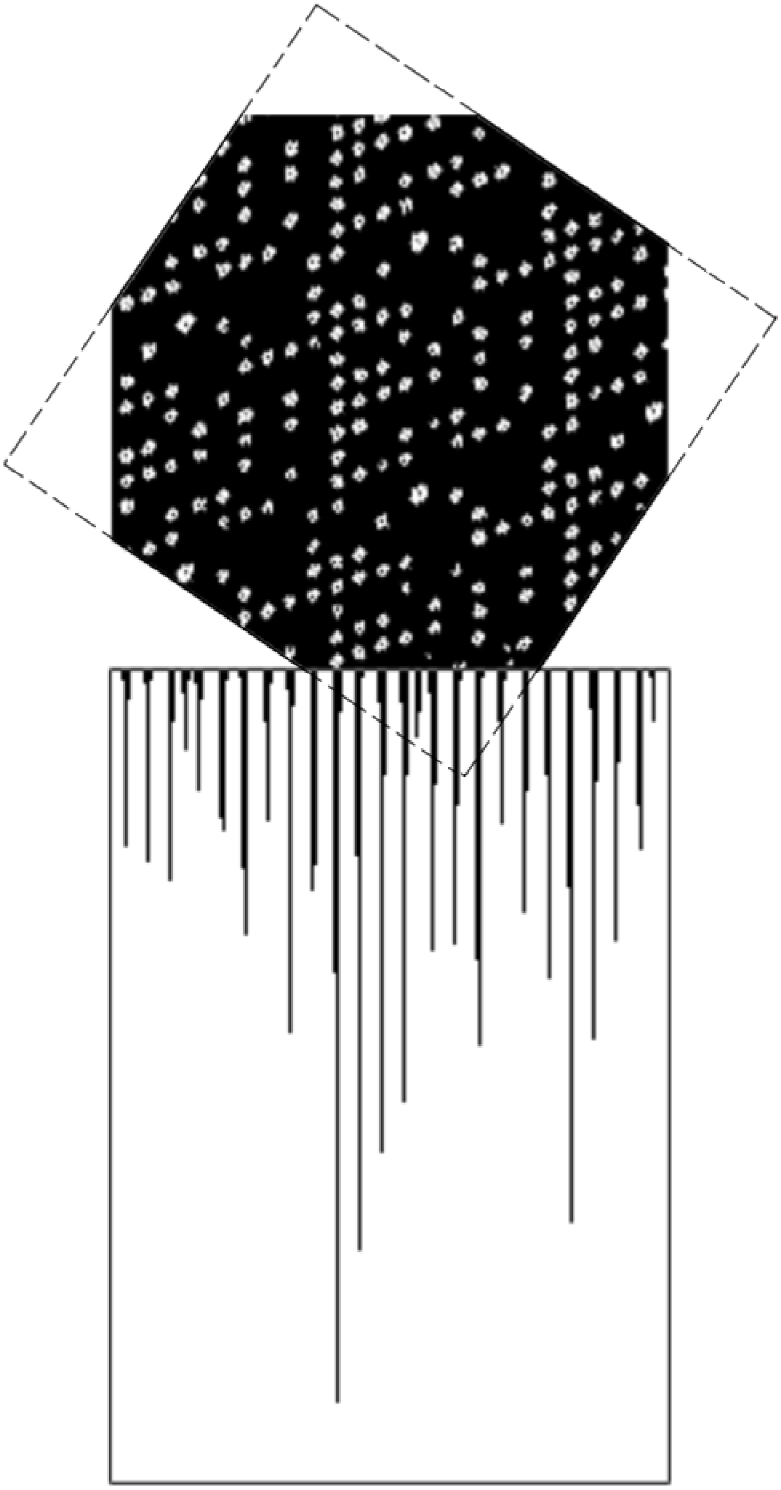

FIG. 8

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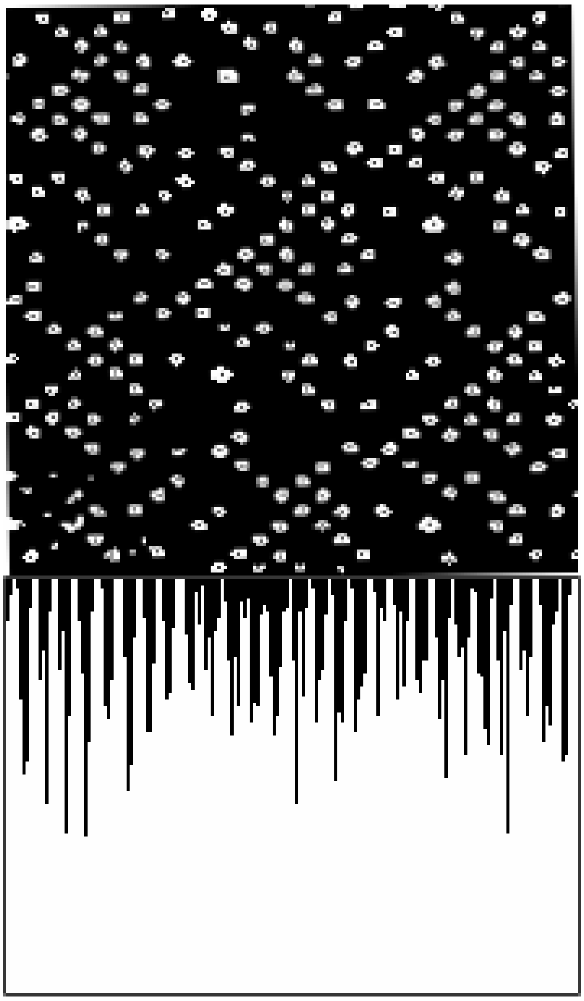

FIG. 9

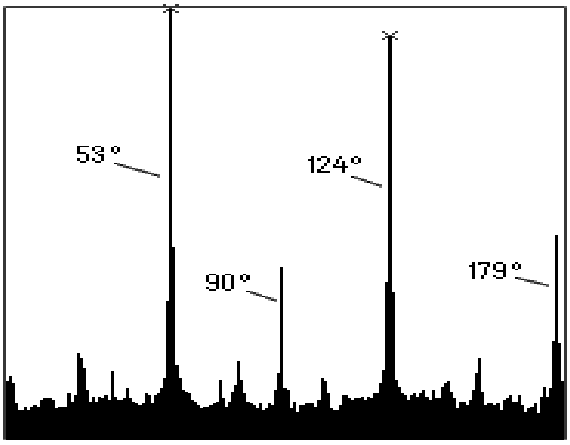

FIG. 10

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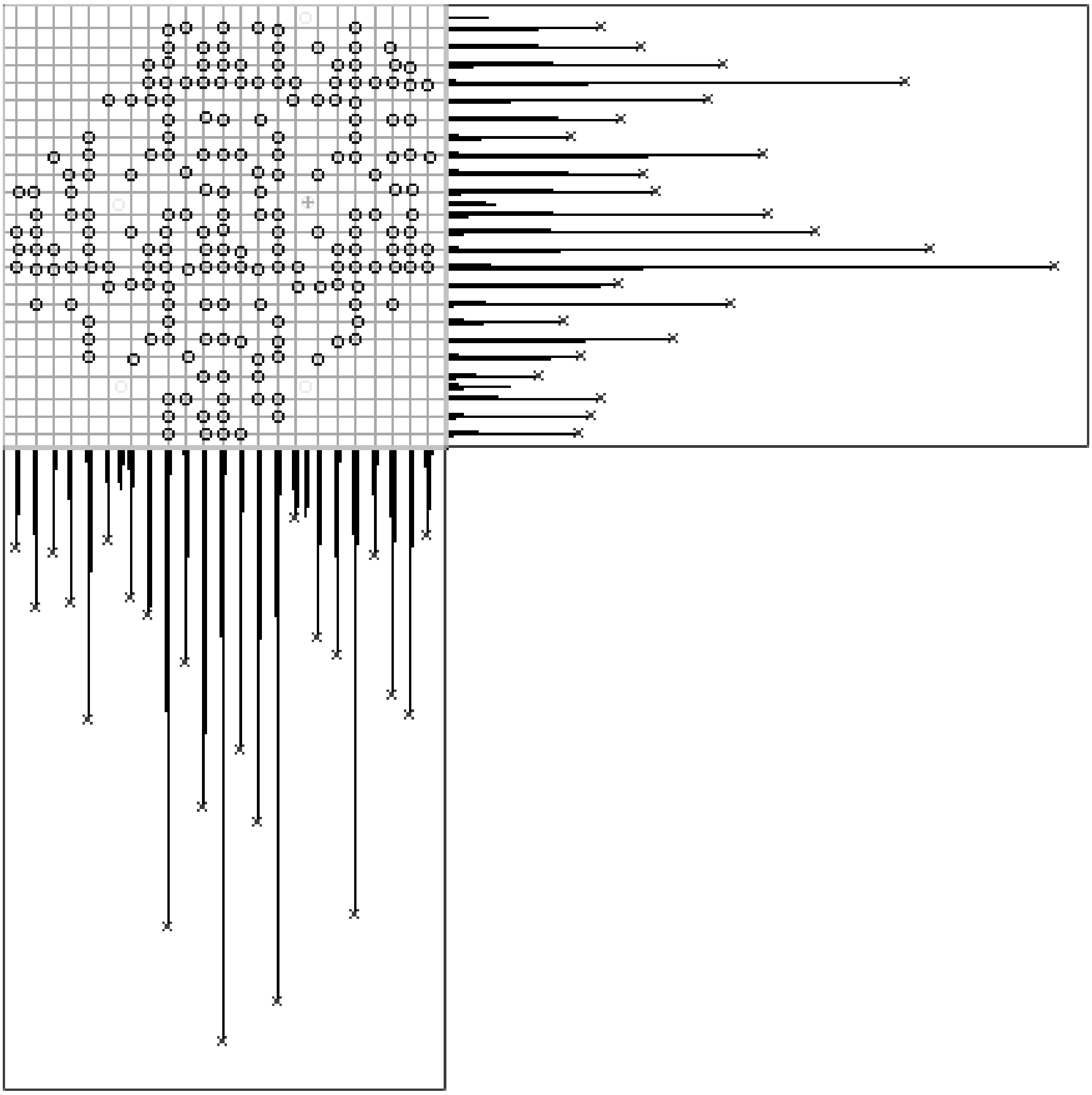

FIG. 11

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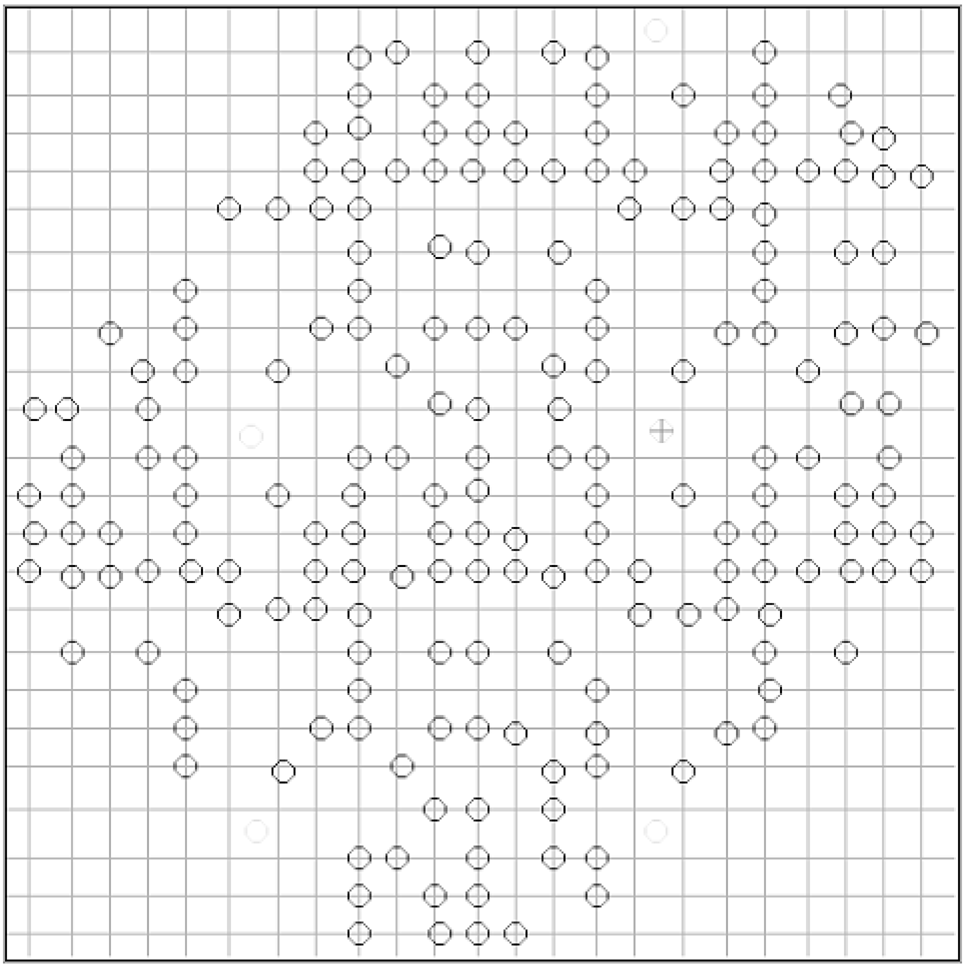

FIG. 12

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