



Information technology — Automatic identification and data capture techniques — Data Matrix bar code symbology specification

TECHNICAL CORRIGENDUM 2

*Technologies de l'information — Techniques automatiques d'identification et de capture des données —
Spécification de symbologie de code à barres Data Matrix*

RECTIFICATIF TECHNIQUE 2

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Replace Clause 9 with the following:

9 Reference decode algorithm for Data Matrix

This reference decode algorithm finds a Data Matrix symbol in an image and decodes it.

- a) Define measurement parameters and form a digitised image:
 - 1) Define a distance d_{min} which is 7,5 times the aperture diameter defined by the application. This will be the minimum length of the "L" pattern's side.

- 2) Define a distance g_{max} which is 7,5 times the aperture diameter. This is the largest gap in the "L" finder that will be tolerated by the finder algorithm in step b).
 - 3) Define a distance m_{min} which is 1,25 times the aperture diameter. This would be the nominal minimum module size when the aperture size is 80% of the symbol's X dimension.
 - 4) Form a black/white image using a threshold determined according to the method defined in ISO/IEC 15415.
- b) Search horizontal and vertical scan lines for the two outside edges of the Data Matrix "L":
- 1) Extend a scan line horizontally in both directions from the centre point of the image. Sample along the scan line. For each white/black or black/white transition found along the scan line resolved to the pixel boundary:
 - i) Follow the edge upward sampling pixel by pixel until either it reaches a point $3,5m_{min}$ distant from the intersection of the scan line and the edge starting point, or the edge turns back toward the intersection of the scan line and the edge - the starting point.
 - ii) Follow the edge downward pixel by pixel until either it reaches a point $3,5m_{min}$ distant from the intersection of the scan line and the edge starting point, or the edge turns back toward the intersection of the scan line and the edge - the starting point.
 - iii) If the upward edge reaches a point $3,5m_{min}$ from the starting point:
 - I) Plot a line A connecting the end points of the upward edge.
 - II) Test whether the intermediate edge points lie within $0,5m_{min}$ from line A. If so, continue to step III. Otherwise proceed to step 1)iv) to follow the edge in the opposite direction.
 - III) Continue following the edge upward until the edge departs $0,5m_{min}$ from line A. Back up to the closest edge point greater than or equal to m_{min} from the last edge point along the edge before the departing point and save this as the edge end point. This edge point should be along the "L" candidate outside edge.
 - IV) Continue following the edge downward until the edge departs $0,5m_{min}$ from line A. Back up to the closest edge point greater than or equal to m_{min} from the last edge point along the edge before the departing point and save this as the edge end point. This edge point should be along the "L" candidate outside edge.
 - V) Calculate a new adjusted line A1 that is a "best fit" line to the edge in the two previous steps. The "best fit" line uses the linear regression algorithm (using the end points to select the proper dependent axis, i.e. if closer to horizontal, the dependent axis is x) applied to each point. The "best fit" line terminates lines at points p1 and p2 that are the points on the "best fit" line closest to the endpoints of the edge.
 - VI) Save the line A1 segment two end points, p1 and p2. Also save the colour of the left side of the edge viewed from p1 to p2.
 - iv) If step iii) failed or did not extend upward by $3,5m_{min}$ in step iii)IV), test if the downward edge reaches a point $3,5m_{min}$ from the starting point. If so, repeat the steps in iii) but with the downward edge.
 - v) If neither steps iii) or iv) were successful, test if both the upward and downward edges terminated at least $2m_{min}$ from the starting point. If so, form an edge comprised of the appended $2m_{min}$ length upward and downward edge segments and repeat the steps in iii) but with the appended edge.
 - vi) Proceed to and process the next transitions on the scan line, repeating from step i), until the boundary of the image is reached.

- 2) Extend a scan line vertically in both directions from the centre point of the image. Look for line segments using the same logic in step 1) above but following each edge transition first left and then right.
- 3) Search among the saved line A1 segments for pairs of line segments that meet the following four criteria:
 - i) If the two lines have the same p1 to p2 directions, verify that the closer of the interline p1 to p2 distances is less than g_{max} . If the two lines have opposite p1 to p2 directions, verify that the closer of the interline p1 to p1 or p2 to p2 distances is less than g_{max} .
 - ii) Verify that the two lines are co-linear within 5 degrees.
 - iii) Verify that the two lines have the same saved colour if their p1 to p2 directions are the same or that the saved colours are opposite if their p1 to p2 directions are opposite to each other.
 - iv) Form two temporary lines by extending each line to reach the point on the extension that is closest to the furthest end point of the other line segment. Verify that the two extended lines are separated by less than $0,5m_{min}$ at any point between the two extended lines.
- 4) For each pair of lines meeting the criteria of step 3) above, replace the pair of line segments with a longer A1 line segment that is a "best fit" line to the four end points of the pair of shorter line segments. Also save the colour of the left side of the edge of the new longer line viewed from its p1 endpoint to its p2 endpoint.
- 5) Repeat steps 3) and 4) until no more A1 line pairs can be combined.
- 6) Select line segments that are at least as long as d_{min} . Flag them as "L" side candidates.
- 7) Look for pairs of "L" side candidates that meet the following three criteria:
 - i) Verify that the closest points on each line are separated by less than $1,5g_{max}$.
 - ii) Verify that they are perpendicular within 5 degrees.
 - iii) Verify that the same saved colour is on the inside of the "L" formed by the two lines. Note that if one or both lines extend past their intersection, then the two or four "L" patterns formed will need to be tested for matching colour and maintaining a minimum length of d_{min} for the truncated side or sides before they can become "L" candidates.
- 8) For each candidate "L" pair found in step 7) form an "L" candidate by extending the segments to their intersection point.
- 9) If the "L" candidate was formed from line segments with the colour white on the inside of the "L", form a colour inverted image to decode. Attempt to decode the symbol starting with the appropriate normal or inverted image starting from step d) below using each of the "L" candidates from step 8) as the "L" shaped finder. If none decode, proceed to step c).
- c) Maintain the line A1 line segments and "L" side candidates from the previous steps. Continue searching for "L" candidates using horizontal and vertical scan lines offset from previous scan lines:
 - 1) Using a new horizontal scan line $3m_{min}$ above the centre horizontal scan line, repeat the process in step b)1), except starting from the offset from the centre point, and then b)3) through b)9). If there is no decode, proceed to the next step.
 - 2) Using a new vertical scan line $3m_{min}$ left of the centre vertical scan line, repeat the process in step b)2), except starting from the offset from the centre point, and then steps b)3) through b)9). If there is no decode, proceed to the next step.