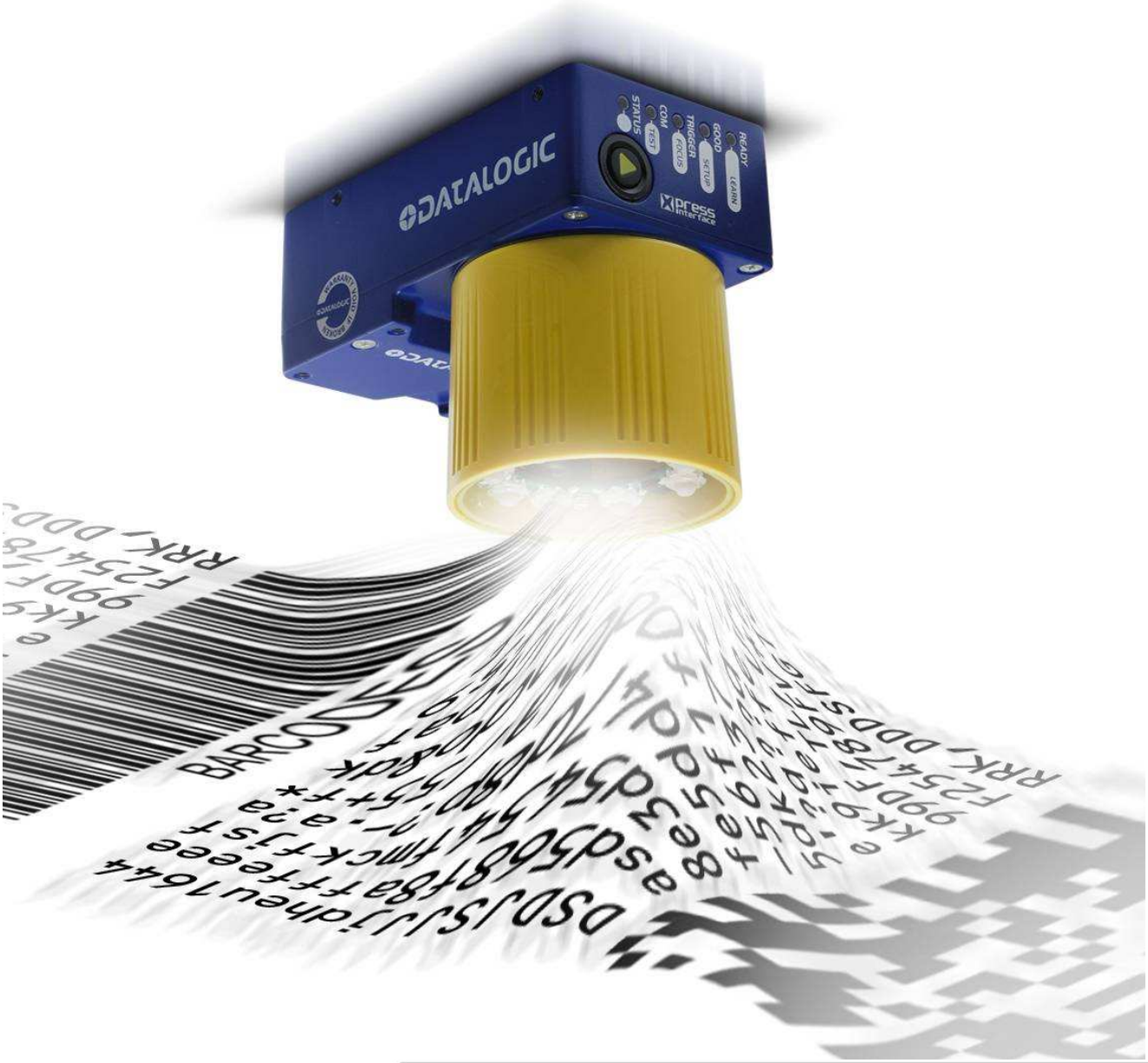
DATALOGIC AUTOMATION

Vision



OCR and OCV Application Guide 1.00

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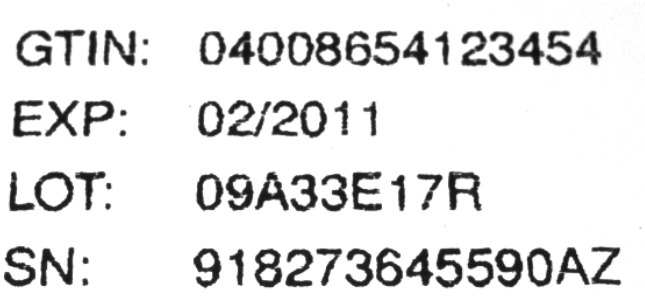
General considerations on OCR

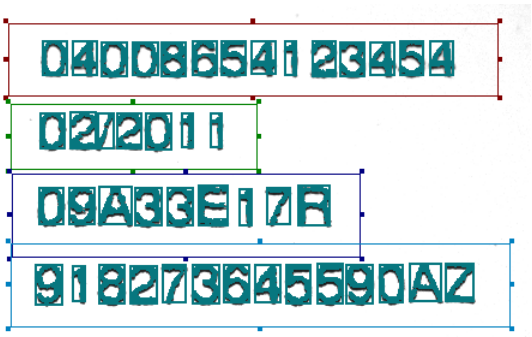
Encoded information into text and codes can be automatically extracted through a 2D imager device. The intrinsic structure of the encoding methods is a crucial factor affecting the readability and the technical approach for the automatic reading, since the existence of different constraints.

A primary advantage of OCR is that encoded information is simultaneously machine-readable and human-readable, while a code, 1D and 2D, is only machine-readable.
On the other side, data encoded in linear and 2D symbols is considerably more reliable for the intrinsic level of information redundancy and protection, being more resistant to quality variation and degradation.

Additionally, both the orientation and the positioning of a code, 1D or 2D, into the scanning area do not affect the correct reading: a 2D barcode reader always features omni-directional reading with also unpredictable code positioning.
Conversely, the automatic character recognition must respect some constraints in relation to the text position and rotation, that are required to be known or should be calculated at run time. In more detail, text can be located through the usage of anchors, that could be barcodes or reference edges.

Unlike codes, having standardize symbols and patterns, the text recognition requires a learning phases where the reader has to be trained over the whole alphabet. The training is a crucial activity since it sets the base patterns that will be used to match the run-time characters. The reading performance is so considerably depending on the quality of the learning phase.





STEPPING THROUGH OCR APPLICATIONS

The proper setup of OCR system permits to achieve optimal level of the readability, top reliability and maximum stability of the performance during the life-cycle.

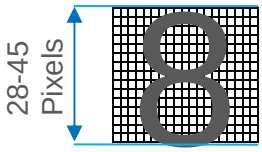
The following part reports the main sequence of operations and crucial hints for an optimal setup.

1. Application Setup

The optical positioning and the setup of the reading head are to be taken into high consideration since their combination determines the system performance and its reliability in the time.

The first consideration is based on the image resolution in relation to the height of the characters. In order to provide an optimal balance between robustness and speed, the resolution in Pixels should meet the condition:

28-45 Pixel/Char height



Increasing the resolution over the recommended range does not increase OCR readability; conversely, larger characters have a negative impact on the decoding time.

Repeatability is a crucial aspect for OCR. Unlike barcode reading, OCR is based on the comparison of run-time character patterns against references, acquired during the initial learning phase.
So, higher the **repeatability** of the characters pattern and features, better and easier the reading.
The variability of the features can derive from many aspects: both the unpredictability of the marking quality and the perspective distortions are typical factors increasing variations respect to the reference condition.

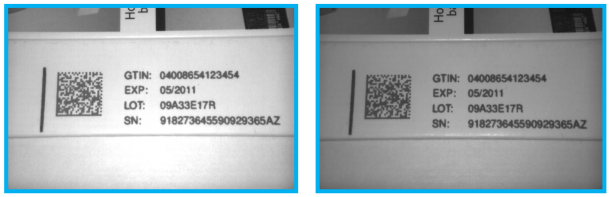
Repeatability also improves with a correct training of the alphabet, that should be based on real operative conditions.

Flat surfaces and **predictable positions** of the scanned text surely help in making easier the configuration and to achieve higher level of performance.

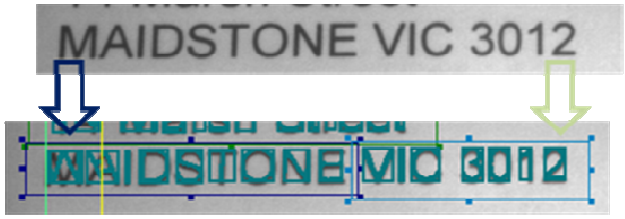
2. Lighting

The lighting selection plays a crucial role in OCR applications.
A proper lighting makes predictable the features of the captures and definitively increases the stability of the reading performance.

As basic and general guideline, **even lighting** improves the quality of the captures and permits an optimal photometrical setup, fundamental condition to boost the contrast of the marked patterns.
Conversely, **“hot”, “cold” spots** or **shadowing** intrinsically create variations and make patterns irregular, with the result of processing time increase.



Multiple regions of interest could be defined in order to group parts of the text with homogeneous characteristics and uniform illumination level.
Into a ROI, segmentation algorithms self tunes on average text features, mainly contrast or spacing. For this reason, an optimal setup is achieved while text fields have features as uniform as possible.



Multiple ROI should be also used when the character set for a certain field is limited, for instance numeric or alphanumeric characters. It helps to enhance decoding time thanks to a reduce subset of the alphabet.

3. Locators

Unlike barcode reading, OCR uses ROI to perform researches and the text must be located into the configured ROI. Small variations of the text position and orientation can be automatically managed by the algorithms without applying location tools.
Small variation are to be intended into the range of:

- Rotation: ±2°
- Horiz/Vert offsets ½ Char Dimens.

Outside the mentioned range, text anchors have to be applied as pre-processing to the normal text recognition.
1D or 2D barcode can be used as text anchors.

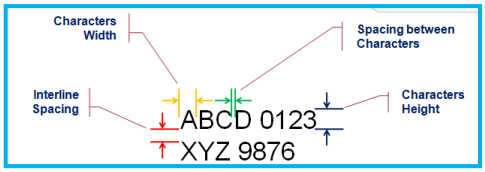
4. Character Segmentation

Once the text region is correctly located, the OCR steps through the **segmentation process**, in order to identify each single character instance that graphically results with the assignment of a rounding box around the character.

The segmentation process depends on:

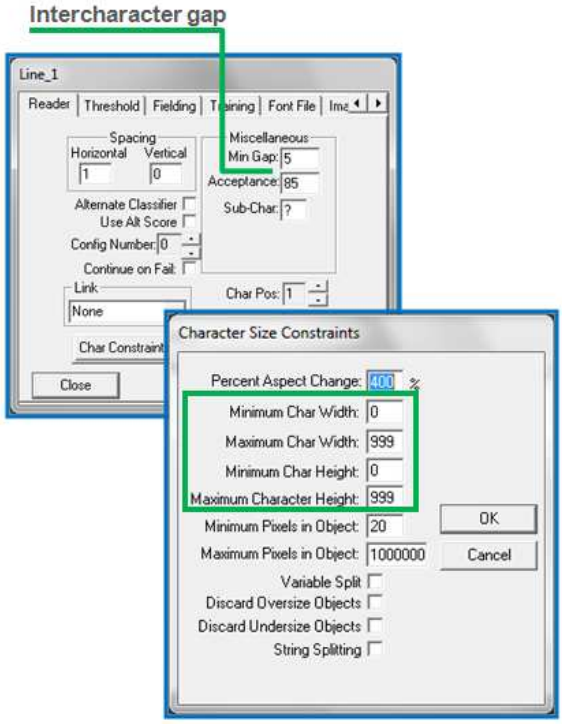
- Characters font
- Character spacing and quite zones around the text field
- Printing quality
- Patterns repeatability

The easiest ways to improve the segmentation process, in robustness and speed, is routing the algorithm through constrains on the research parameters.



Bounds can be introduced on:

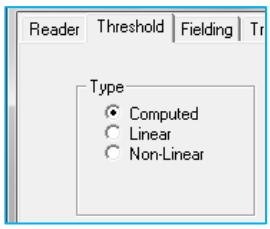
- Characters **Height**
- Characters **Width**
- Characters **Spacing**

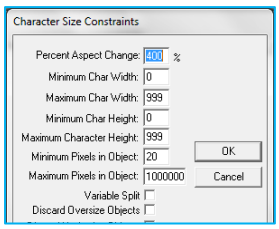


Min Gap parameter defines the minimum gap between characters; it is important to enhance the speed of the segmentation process.

In addition to the standard **linear segmentation** method, expected to manage a large part of cases, other two segmentation methods are implemented, based on **non-linear and compounded** algorithms.

The variable split of characters can be applied to critical cases where the spacing between characters cannot be fixed or predictable.

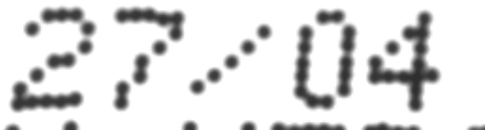




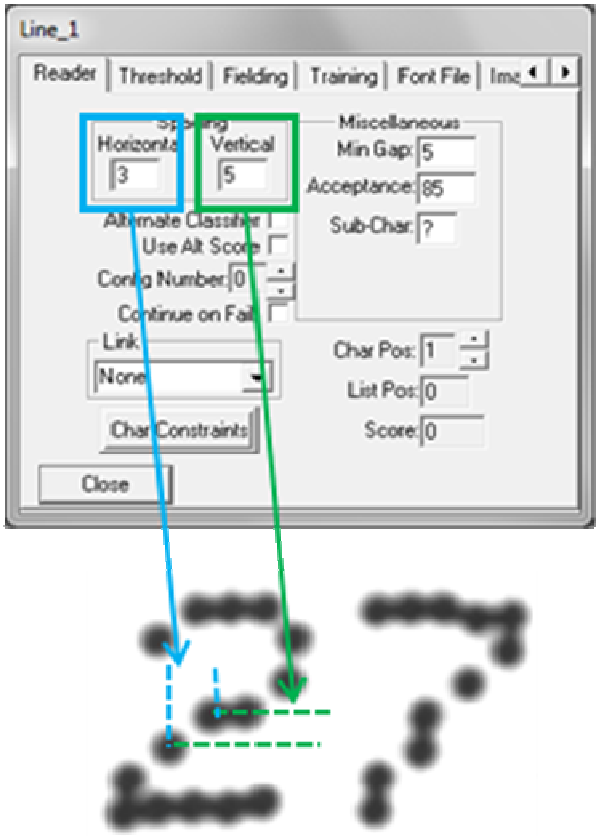
Touching characters generally increase the complexity and the setup time.

As general rule, OCR algorithms are much more reliable and faster when a good separation between character is guaranteed. Touching characters increase the risk of un-decoded cases or even of character substitution.

Dot printed characters are present in many application, especially in the Food and Beverage industry.



The segmentation for dot printing charcacrtes must be improved applying constraints to characters features:



The orizontal and vertical spacing constraints permit a proper character segmentation, since they lead the algorithms to group and split patterns depending on the real features of the font in use.

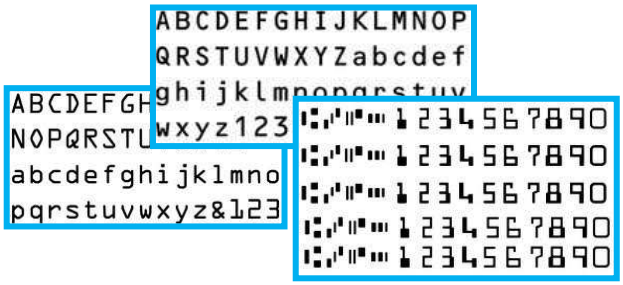
5. TRAINING

The font of the text is a fundamental aspect affecting both the readability and the reliability of the reading.

During the training, the reference characters patterns will be fixed and then used to match run-time characters. As consequence, the reading performance depends on the quality of the learning, that should be based on the real production characters variety.

OCR function of MATRIX is really performing and flexible: it supports true types fonts for a broad range of applications.

Nevertheless, OCR fonts remarkably simplify the segmentation setup and process: OCR fonts guarantee a better level of readability and also contrast character substitution, an occurrence increasing while coping with poor printing quality or life-time degeneration.



Whether the variability of character features is high and it gets complicate to address with a single pattern for character, the easiest way is to train multiple instances of the same character pattern.
On the other side, the over-training must be avoided since larger the reference set, higher the decoding time.

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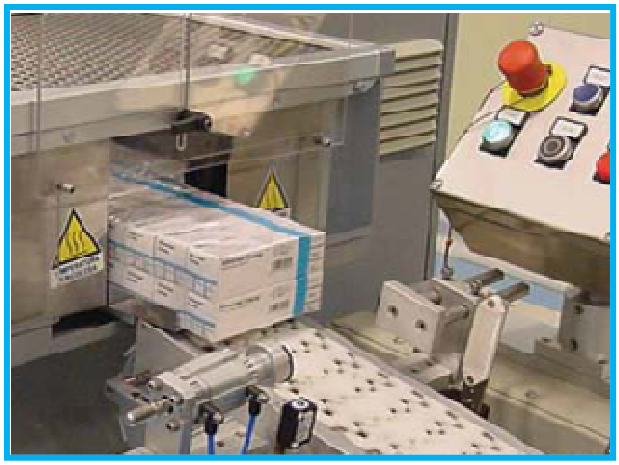
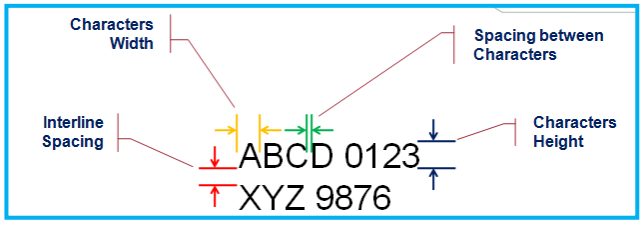
PHARMACEUTICAL PACKAGING

Description

New standards are being progressively adopted for the traceability of pharmaceutical goods. Crucial data as product Identifier, serial ID number, lot code and expiration date are encoded into a Data Matrix 2D code. Such information is also replicated into 3 or 4 human readable text fields.
Track and trace applications require reading the complete set of data, both the barcode and the text fields.



Main Requirement



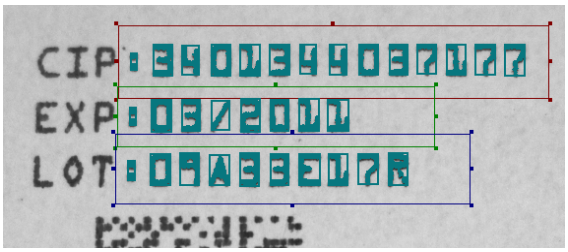
Font	OCR –B,
Printing Method	Ink Jet Dot Printing
Char Spacing	1 mm
Line Spacing	2 mm
Char Height	4 mm
Char Width	2 mm

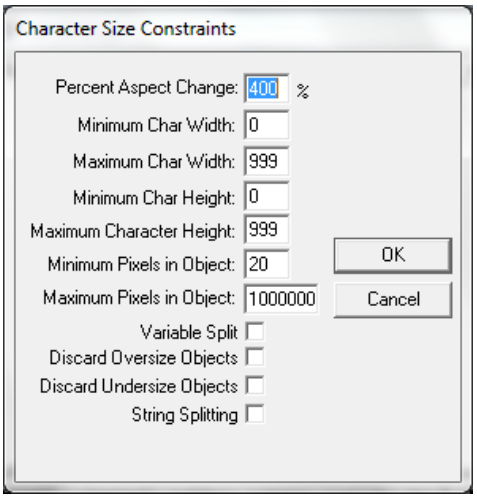
Typical constraints

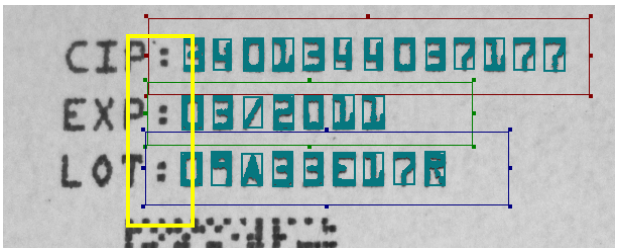
- Low printing quality or degradation in time
- Dot printing
- Small spacing between lines
- Character distortion for high line speed
- Ink reflection just after printing

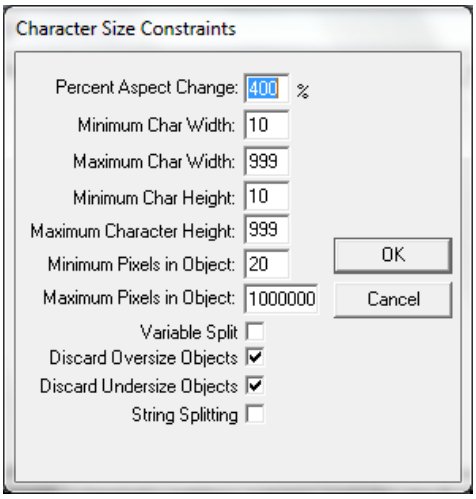
DLReader parameter Setup

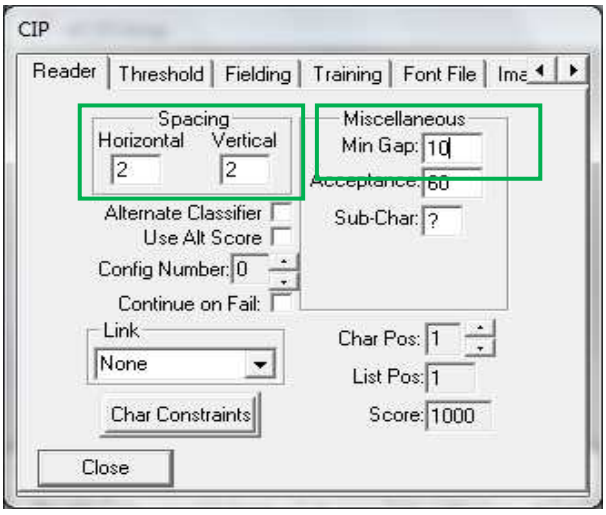
Symbols can be filtered out introducing bounds on the accepted dimensions

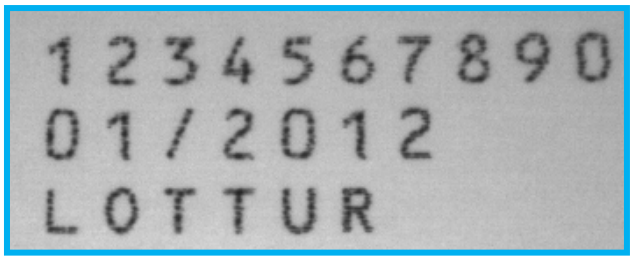






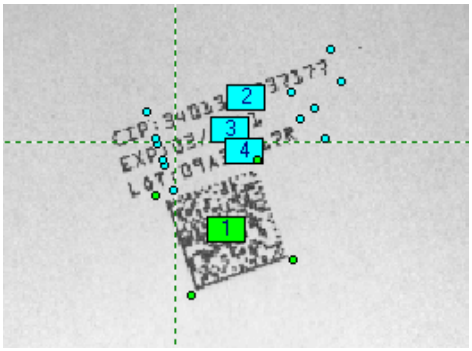






The **Horizontal and Vertical spacing** improves the robustness against printing holes.

The **Min gap between characters** helps to skip the inspection in the inter-character areas and hence improves the speed.



The text location is operated through the 2D code, that is used to retrieve the positional information of the text on the scanned plane.

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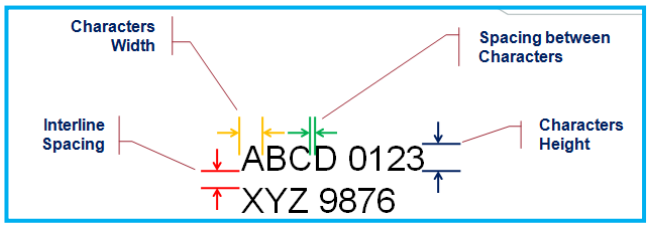
DOCUMENT HANDLING

Description

The application requires the reading of the text in order to identify wrong sequence number before folding the sheet into the envelope.

The processing speed is demanding for this type of applications and represents a relevant constraint on the computational time for the identification system.

Main Requirement:



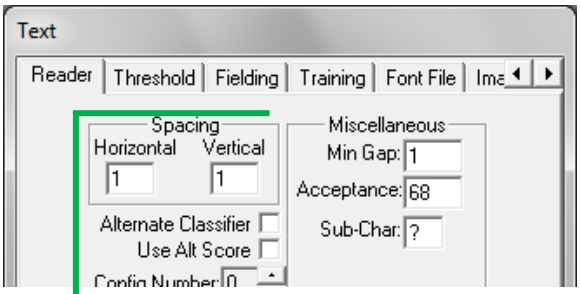
Font	OCR-B True type
Printing Method	Laser Printing
Char Spacing	0.5 mm
Char Height	3 mm
Char Width	3 mm

Typical constraints

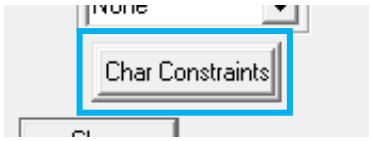
- High Speed / High throughput
- Good printing quality
- Verification Text vs Barcode

DLReader parameter Setup

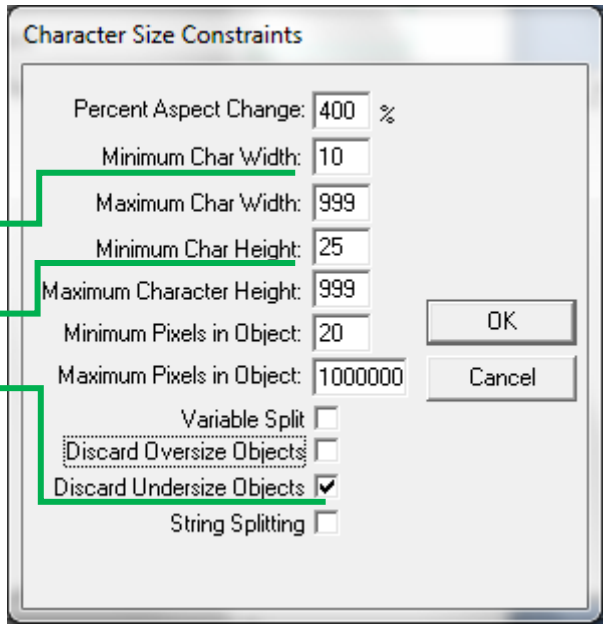
When the quite zone around the text is limited, the characters segmentation must be configured in order to avoid the merging of external patterns into valid characters.



The vertical spacing parameter defines the maximum number of pixels between black patterns to aggregate into a character. it helps to filter out black spots not belonging to the character, along the vertical scan.



The introduced constraints, on the min/max width and height, make the bars not considered as potential characters.
The Discard options must be enabled in order to make effective the rejection of the patterns violating the conditions.



When the image contains only one barcode, 1D or 2D, and a text string, the match can be enabled. The OCR bases the recognition on the code content, so improving the robustustness and the speed respect to the normal OCR decoding.

AUTOMOTIVE - WIP

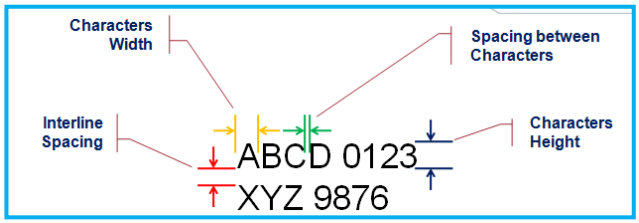
Description:

The application requires to read the car identifier reported on a label.

The text is coupled with a DataMatrix code, that can be used to locate the text into the area.

Both barcode and text must be identified.

Main Requirements



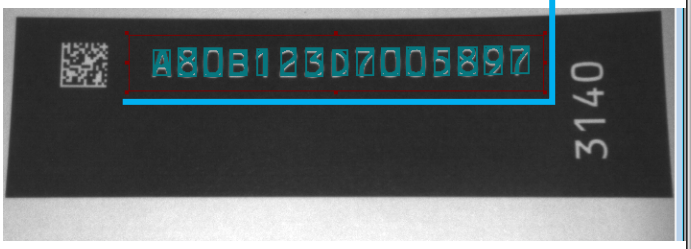
Font	True type
Printing Method	Laser Printing
Char Spacing	1 mm
Char Height	4 mm
Char width	3 mm
Text Orientation	Horiz. And Vert.

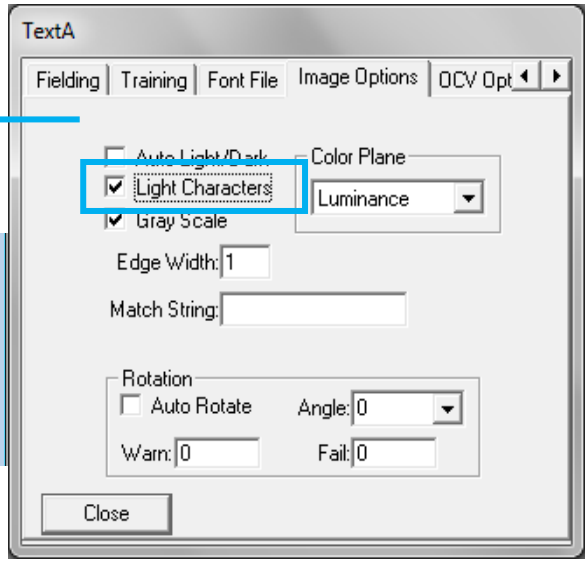
Typical constraints

- Horizontal and vertical text simultaneously
- Good character definition
- Label printing
- Background Texture

The default parameter configuration is unable the manage the case of light text on a dark background.

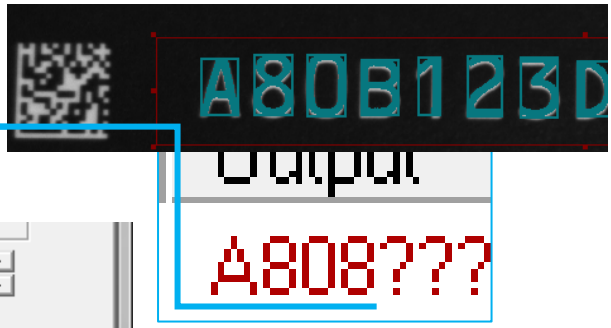
White text on a dark background can be managed through the Light Characters Option.

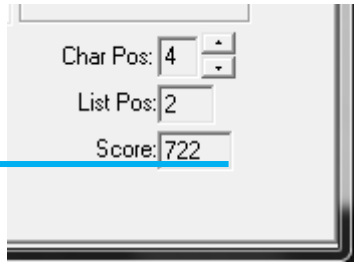




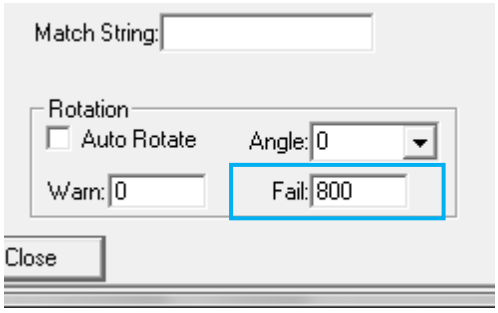
When characters have similar patterns, the risk of substitution increases.

In the reported example the comparison of the character ‘B’ against the character ‘8’ pattern produces an high correlation score.





The recognition score threshold can be adjusted in order to properly discriminated between different patterns. The threshold value should not be too high since it affects the correct algorithm selectivity and it may result in discarding valid characters when small acceptable variations respect to the reference pattern occur.



FOOD - Packaging

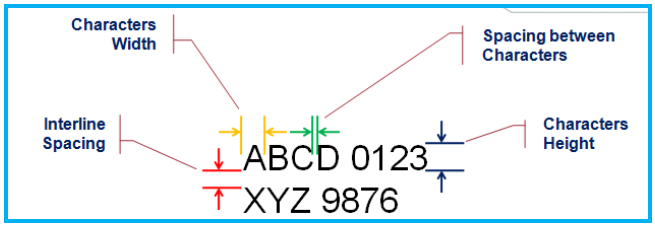
Description:

The expiration date must be inspected and verified along the production process.

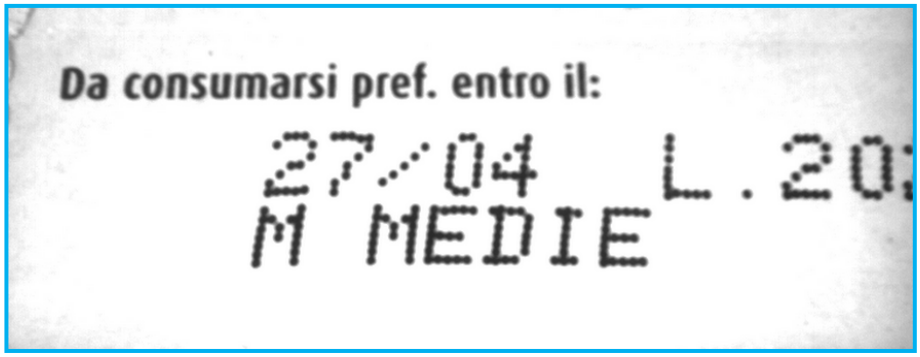
Though the low line speed, the text font and the marking method (dot printing) require a specific and accurate reading setup.

The text field can horizontally shift, in the range of 10 mm around the average triggering position; no barcode is available to be used as text anchor.

Main Requirement:



Font	True type
Printing Method	Ink Jet Dot Printing
Char Spacing	0.5 mm
Line Spacing	0.5 mm
Char Height	3 mm
Char width	2 mm

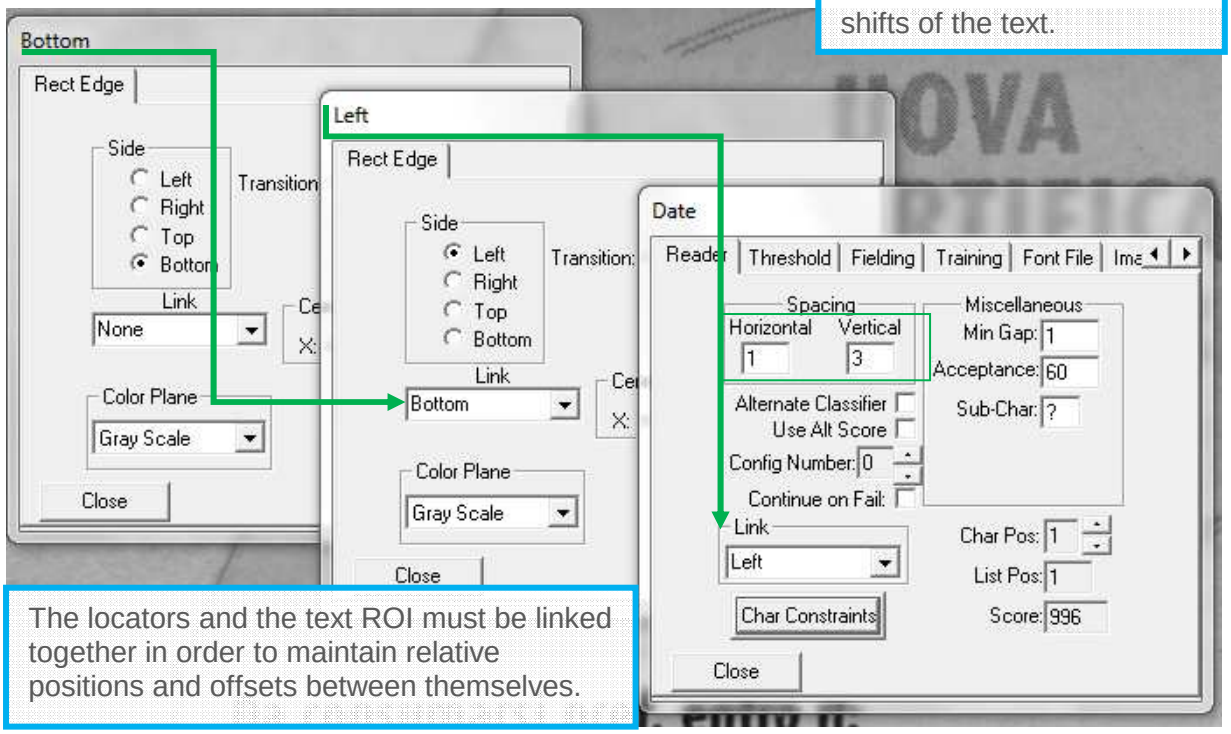


Typical constraints

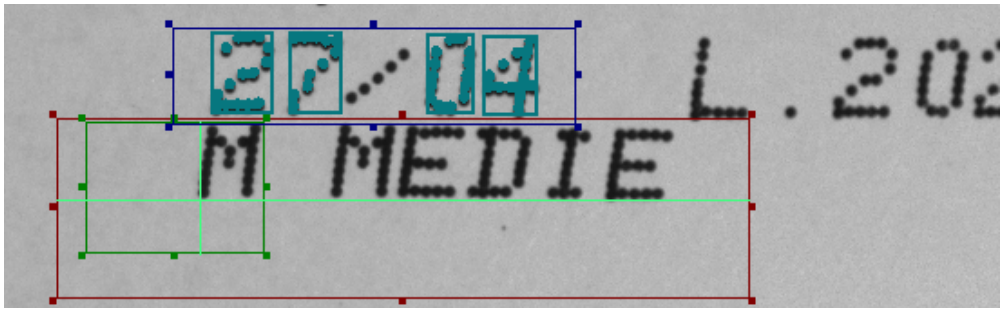
- Text shifts
- Dot printing
- Printing contrast degradation

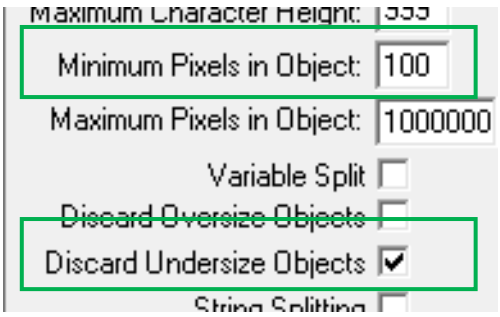
DLReader parameter Setup

The text can be located using the EDGE Locator function. It helps in compensating the horizontal and vertical shifts of the text.



The locators and the text ROI must be linked together in order to maintain relative positions and offsets between themselves.





The slash symbol can be filtered out of the recognition using a bound on the minimum number of pixels/character accepted.

The verification on the deciphered text against the expected data content is integrated as a standard functionality.

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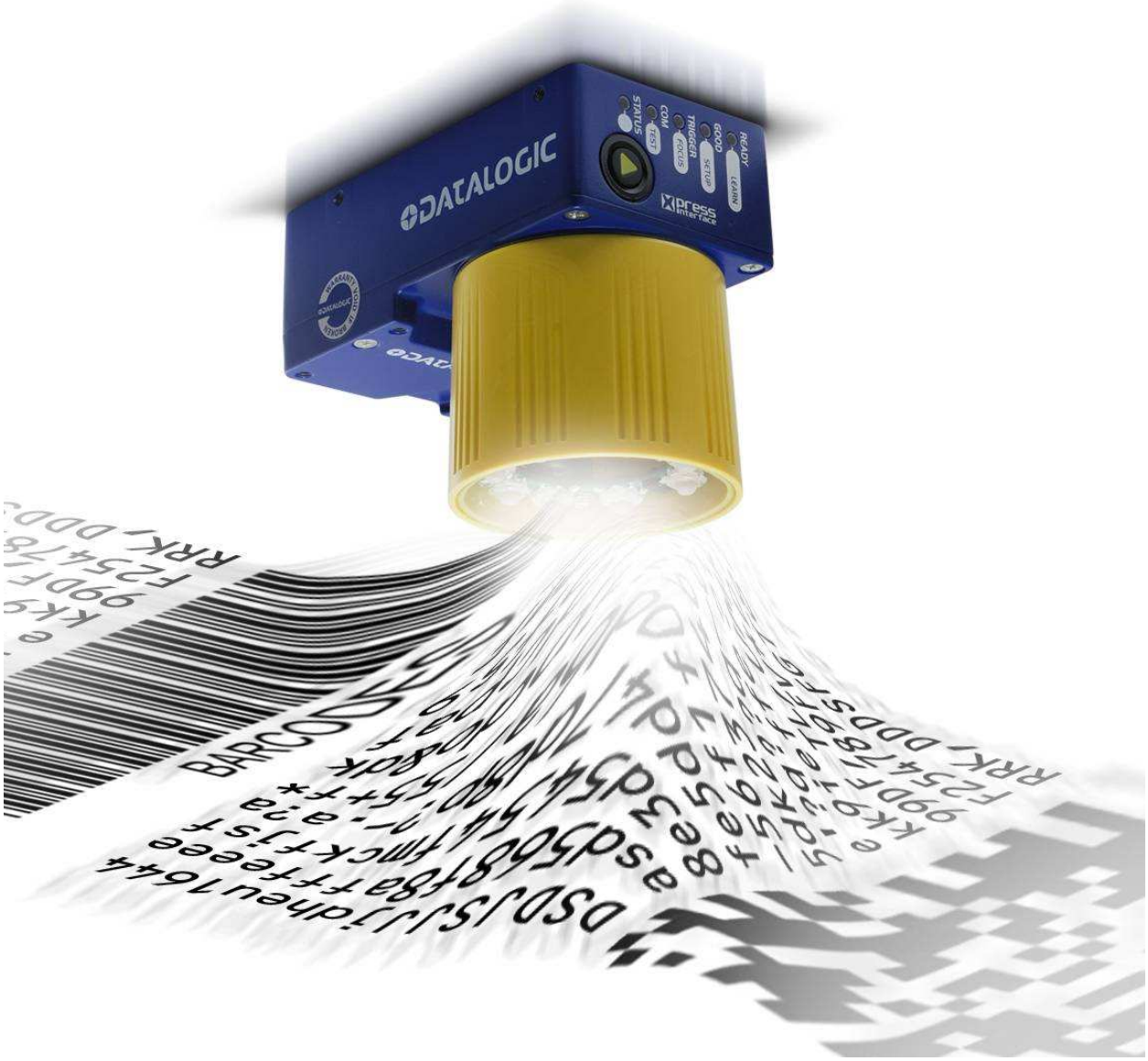

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