VaxOCR Genesis
ON CAMERA Version

User Manual

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Version 1.0

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1. Contents

2. Introduction

VaxOCR Genesis is a high-performance generic OCR reader developed by Vaxtor Technologies to read any combination of uppercase Latin characters and/or numbers arranged in up to three lines. Operating under any lighting conditions, it is unaffected by image quality, print degradation and font shape variations.

The software can be user-configured to read a variety of items including: ID cards, passports, stock labels, shipping labels, delivery notes, tickets & receipts, product codes, fast food till receipts, bank notes, vehicle signage, VIN codes, video OSD text etc.

Complex syntax rules can be defined to read and report the text correctly.

The generic OCR engine takes advantage of many of the current integration and publishing capabilities that have been developed by Vaxtor over many years.   The reads can be written to the Axis internal SD card (if fitted), a shared network drive, sent to Helix (Vaxtor's comprehensive Back Office program which can be PC or cloud based), or data can be sent to many other destinations and VMS systems such as Milestone and Genetec using the comprehensive list of reporting options.

This manual will guide you through the installation, configuration and these result publishing procedures. It also includes some tips about camera setup and configuration to maximize the OCR analytics performance and read accuracy.

Note that a separate version is also available which runs on PC platforms running Microsoft Windows or Linux operating systems.   Contact Vaxtor for more details.

3. Requirements for Images

OCR (Optical Character Recognition) is an image processing technology used to locate and read text which can be printed onto a variety of substances such as paper, card, thermal paper, plastics, wood, metals etc. using a variety of methods and fonts. However, recognizing the characters is more challenging if the images have any of the following characteristics or artifacts:

- Over / Under exposed
- Blurred or distorted text
- Unevenly lit
- Very Low contrast
- Damaged or worn text
- Bad weather conditions if outdoor deployment on say vehicles or containers.

The less clear that the text images are, then the more likely it is that the OCR software will report them incorrectly -- Garbage In –> Garbage Out.

As a general guide, if a human has difficulty reading the codes, then so will an intelligent OCR camera!

4. Camera Requirements

The software will run on any Axis camera with an **ARTPEC-6** or 7 processor or later.
Most current Axis models have these processors and normally a high resolution capable of reading label, object or vehicle text. The software will also run on some of Axis's intelligent doorbells where it could be used to read ID cards or shipping labels.

4.1 Frame Rate

The frame rate, also known as frames per second (FPS), is the number of frames or images that the camera can capture per second. For example, 30 fps means the camera captured 30 frames in a single second of video.

When using VaxOCR On-Camera, then setting the frame rate has no effect, – the camera sends frames at about 25fps to the App. However, if you use the camera as a remote IP OCR camera connected to a PC running the Vaxtor's OCR software – then the fps settings will have an effect and it should be set to at least 25fps for moving objects.

4.2 Shutter Speed

Shutter speed, also known as the "exposure time", is the length of time a camera shutter is open for in order to expose light onto the camera sensor. The shutter speed is measured in seconds, or fractions of a second. The bigger the denominator, the faster the speed. For example, $1/250^{th}$ means one two-hundred-and-fiftieth of a second or four milliseconds.
(1 second = 1000 milliseconds)

The following minimum shutter speeds are suggested as a general guide:

Container speed:

- **Stationary object** ⟶ Min exposure time **$1/125^{th}$ sec** (8 milliseconds)

- **Very Slow-moving object** ⟶ Min exposure time **$1/250^{th}$ sec** (4 milliseconds)

- **Medium to Slow moving** ⟶ Min exposure time **$1/500^{th}$ sec** (2 milliseconds)

Fast moving objects (such as labels on fast conveyor belts) cannot be read. In this case use the PC version and connect the camera via RTSP for example.

4.3 Resolution and Lens Focal Length

4.3.1 Resolution

The resolution of the camera determines the amount of detail that can be captured. The smaller the object detail, the higher the resolution that is required.   There are several factors that determine the detail captured:

1. The resolution (pixel size) of the camera sensor. This sensor (normally CMOS) where the light eventually falls and a typical IP camera has a sensor resolution of 2 or 4 Megapixels.

2. The resolution of the camera's electronics. An Axis P3245 dome camera can output video at a resolution of 1920 x 1080 – but may be set to a lower resolution if not needed.

3. The quality and focal length of the lens. The quality of the optics can play a part in challenging circumstances.   The focal length (zoom factor) determines the field of view that can be seen.

4.3.2 Focal length

The focal length of the lens determines how "zoomed in" the image is. It is usually expressed in millimeters (e.g., 6 mm, 25 mm, or 50 mm).

The focal length tells us the angle of view (how much of the scene will be captured) and the magnification (how large individual elements will be). The longer the focal length, the narrower the angle of view and the higher the magnification. The shorter the focal length, the wider the angle of view and the lower the magnification.

In the case of zoom lenses, both the minimum and maximum focal lengths are stated, for example 10–40 mm.

4.3.3 Illumination

Labels and receipts etc. must be evenly illuminated with diffused white light so that it can be read at a reasonably fast shutter speed without the camera adding too much gain to brighten the image. (a maximum gain of about 12 is advised)

Adding gain effectively amplifies the video signal, including any noise which can result in a very grainy image and prone to OCR errors.

5. Other requirements

The positioning of the camera is key to achieving maximum OCR accuracy.

5.1 Camera Orientation and Placement

The image orientation is a key factor to achieve the maximum OCR efficiency. It is recommended that you stay within the following thresholds:
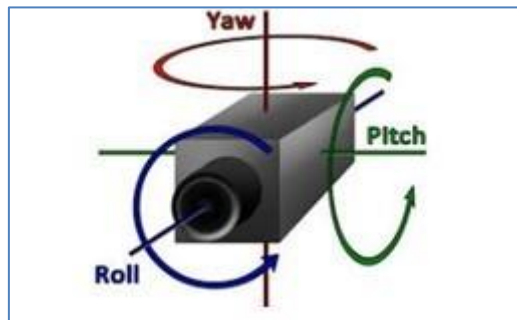
Roll Rotation: Below 25°

Yaw Rotation: Below 25°

Pitch Rotation: Below 25°

In other words, keep the camera as perpendicular to the object to be read as possible. Accuracy will decrease significantly if these guidelines are not adhered to.

5.2 Examples of camera orientation

The following examples illustrate various camera and object orientations.

The first example is perfect but not always possible, however the software is very tolerant to real-world conditions.

5.3 Character pixel height

The most accurate way of measuring the size of the characters on an object is to use the height of each character. The optimal range is from 20 to 30 pixels high. There is a tool to help determine the correct lens to use to attain this height described later in this manual.

The software can be configured to read characters as low as 14 pixels high – or as high as 70 pixels high, but in order to maximize reading accuracy and not waste processor time looking for very large characters you should try to keep to this 20-30 range.
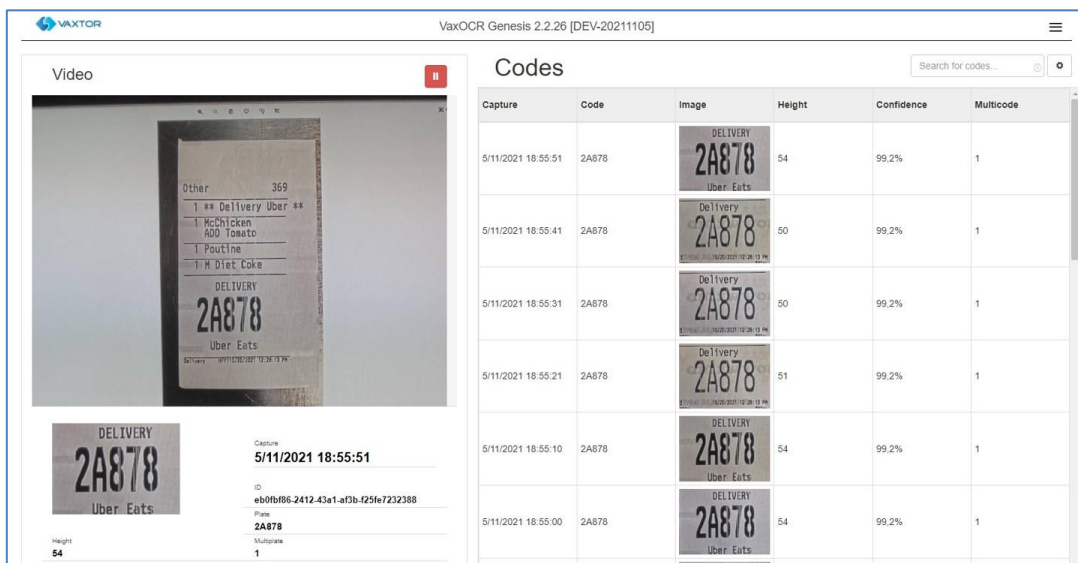
6. Speed of a moving object / camera

The software may be run onboard an Axis camera as described in this manual, but may also be run on a PC or server and the Axis cameras used to send live video to the PCs for processing. This is used for faster moving objects.

The Axis camera's processor (ARTPEC 6 or 7) can take several seconds to process a complex label and so in this case the label must be stationary or moving very slowly.

(This is due to the huge variance in possible locations, qualities and orientation of text and can also depend upon the complexity of the background)

Very simple labels can be read much faster. In the following example the ticket took over 500ms to read on an Axis dome camera.

However, by connecting the video stream to a PC and running the On-PC version of the Vaxtor application then higher speeds are possible. In the above example a fast PC took around 95ms.

Several Axis cameras may be connected to one PC for centralized processing.
Contact Vaxtor for further details.

7. Setting up the Axis Camera

Once the Axis camera has been installed on site it must be set up and configured. Use a web browser to logon to the camera using its IP address. *(Please refer to the Axis documentation for the default IP address. The default username and password are normally: root / root).*
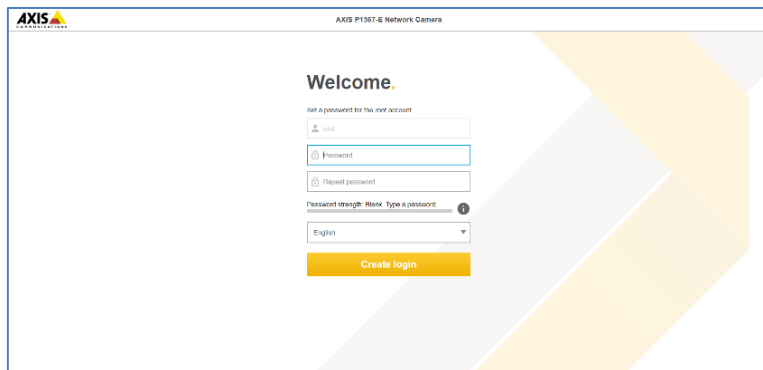
Once logged on, select "Settings" from the bottom right of the window:
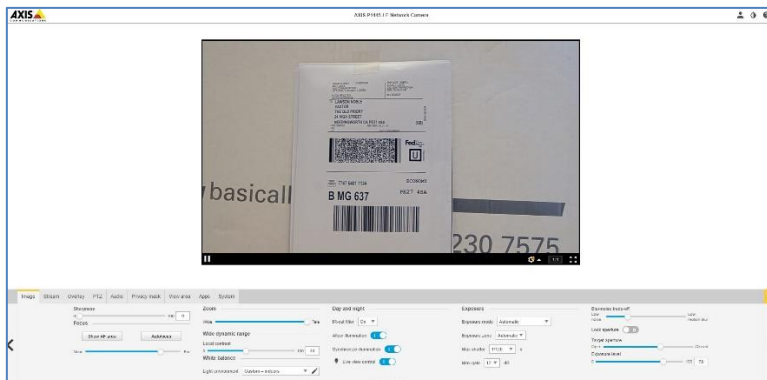
7.1 Set the date and time of the camera

To set the **date and time** within the Axis camera, select the "System" Tab and choose the Date & Time option.
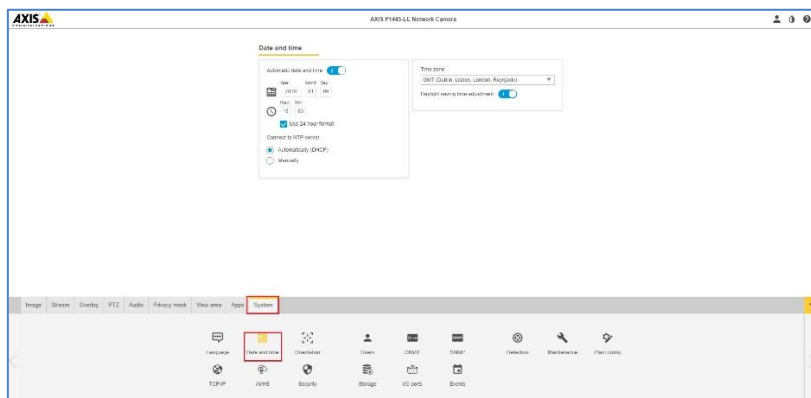
Axis camera setup: System > Date & Time

In this example we are using one of the UK Stratum 1 NTP Servers:
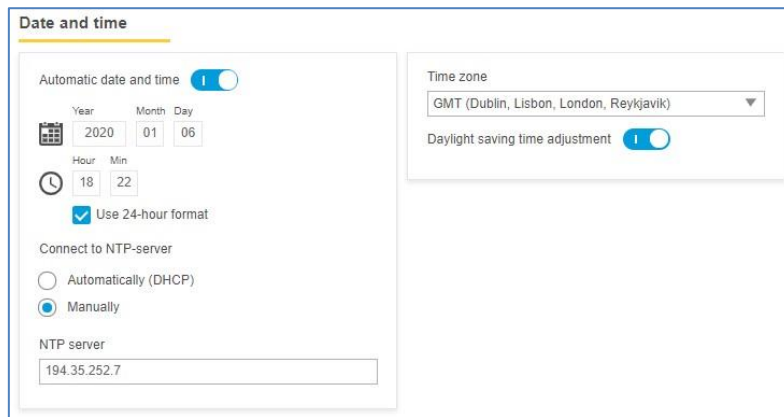
7.2 Set the resolution, shutter speed and frame rate

Different frame rates, shutter speeds and resolutions should be setup depending on where the camera is to be placed. See section 3 for shutter speed recommendations and note that for on-camera use the frame rate has no effect.

7.2.1   Set the View Areas if required

On some the Axis cameras, you can define one or more View Areas.
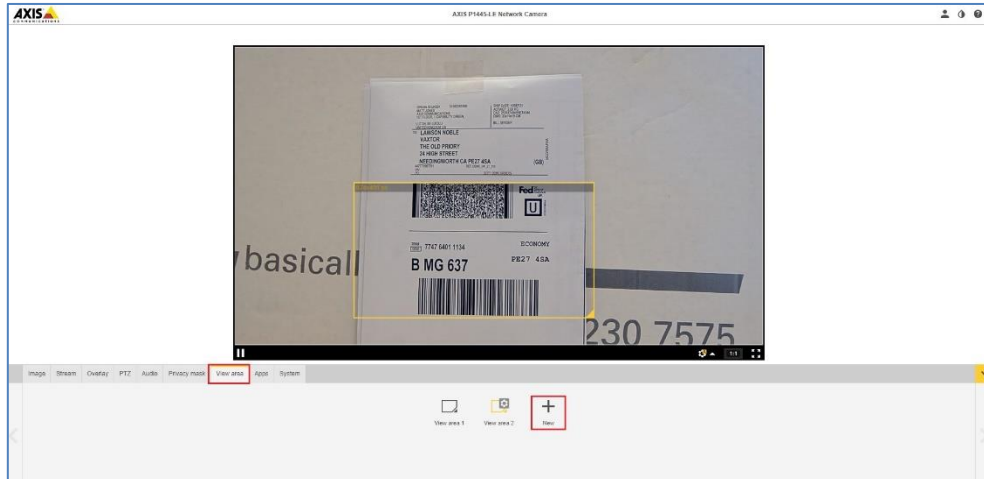
These rectangular areas can be named and are essentially areas of interest which reduces the bandwidth of the data transmitted to a remote recording device and equally saves storage space when video is saved remotely or on the camera's internal SD card if fitted.

In this example only the area bounded in yellow will be sent to any recording equipment – and only this part of the video image will be passed onto the OCR engine for OCR processing.

Note that you can also set multiple Regions of Interest (ROI) within the OCR App which can be defined as polygons and the bounded areas can be included or excluded from the OCR processing. See later in this manual.

7.2.2 Set the frame rate and resolution for each View Area

If you are using View Areas then for each rectangular View Area set the **frame rate (max)** and **resolution** in the Axis camera.

- Click on the Stream Tab and choose the appropriate View Area:
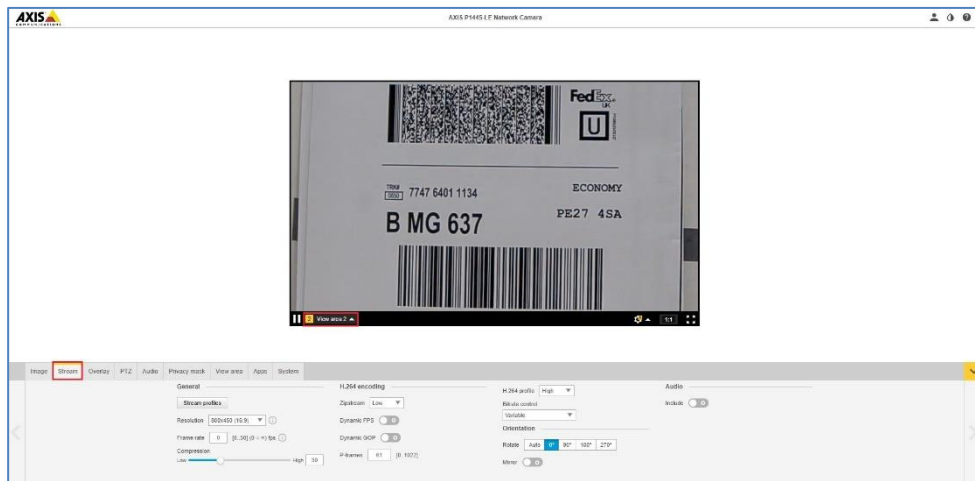
- Next, select a suitable resolution.
  Tip: do not select a resolution that is more than is needed for the OCR:
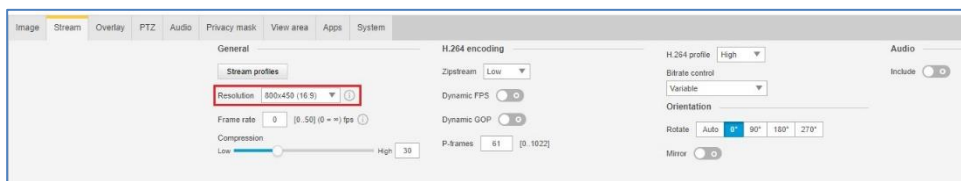
- All the other Stream options have no effect on the On-board OCR.

7.2.3 Setting the shutter speed and other important image settings

To set the **shutter speed (minimum exposure time)** and other important settings in the Axis camera, we need to click on the Image Tab. The following window is displayed:
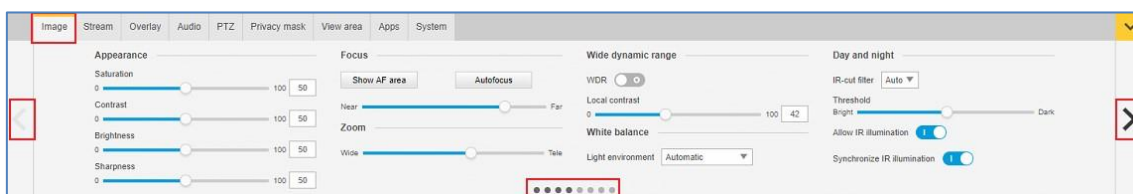
Note that these menus have side-scrolling arrows to the left and right to scroll through all the Image setting options.

Set the following:

- **Maximum Shutter speed (maximum exposure time). See Section 3.2**
- Set the **IR-cut filter** to **On** in the Day and Night section. This causes the filter to be present on color images (to remove IR light interference / color distortion) and this keeps the camera in Day Mode. Note that sufficient white light should be provided to be able to read the target text day/night without the need for excessive gain whilst maintaining a high shutter speed.
- Set the **Max gain** to 12dB or below to reduce noise on the images.
- Deselect the **Enable IR Illumination** checkbox in the IR Illumination section.

Other settings

In Appearance, it is advisable to set **Sharpness** to midway or lower. You do not want the camera altering the pixels in any way by enhancing edges.

Target aperture – this controls the iris and should normally be midway. A smaller iris (towards closed) will increase the depth of field but cut down the light received.

Exposure level – this setting will attempt to lighten or darken the resulting image – subject to the gain, iris and shutter settings. Normally leave midway.

Blur-noise trade-off – Low noise means shutter priority, Low motion blur means gain priority. Leave this pointer about a third of the way up as your maximum shutter speed will determine when the aperture will start to change.

8. Installing and configuring the VaxOCR Genesis software

Once the Axis camera is installed and setup, we need to install and configure the VaxOCR On Camera software. The following steps are recommended:

1. Install the software
2. Upload the license key
3. Restart the Axis Camera
4. Start the software
5. Configure the software

8.1 Installing the software

To install the VaxOCR Genesis On Camera software, do the following:

1. Contact Vaxtor for the latest version of the VaxOCR Genesis software for Axis cameras. It should look something like:

More recent Axis cameras all have ARTPEC 7 processors. The software will run on ARTPEC 6 and above.

2. In the Axis camera´s settings section, click on the Applications (Apps) tab.
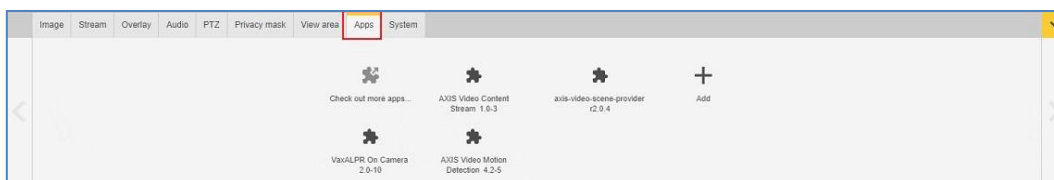
Axis camera setup: Apps > Add

3. Click the + *(Add button)* and browse for the file e.g. V**axOCR_Genesis_2_2_26_armv7hf.eap**
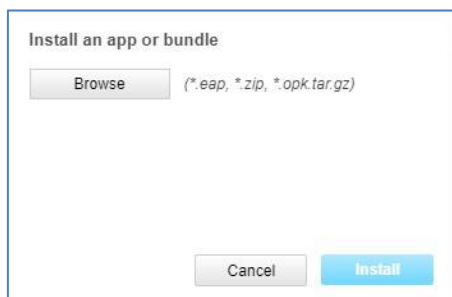
Axis camera setup: Apps > Add > Browse

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4. Click the **Install** button to install the software.

5. After installation the App will appear on screen.
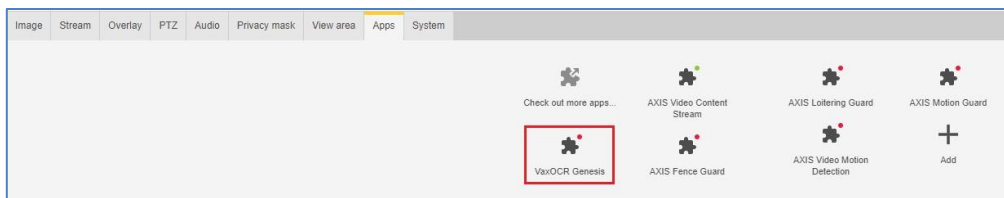
Axis camera setup: Applications > Overview

NOTE: If you encounter any issue whilst installing the software, upgrade the Axis camera firmware to the latest version available for your specific product model.
Do this in the Axis System / Maintenance menus.

8.2 Upload the license key
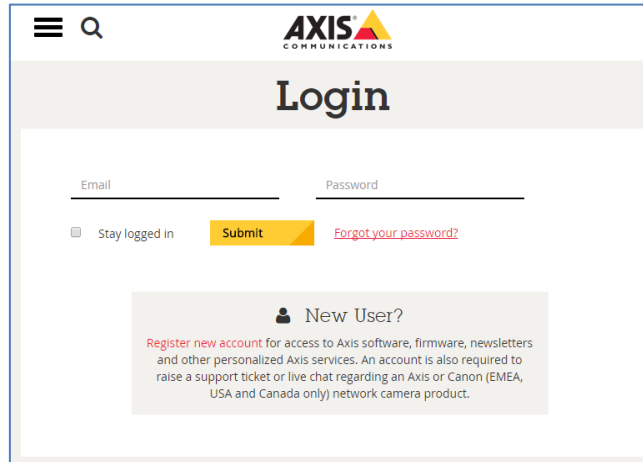
The VaxOCR Genesis On-Camera software requires a license key. Whether you need a trial license (30 days) or already have a paid-for permanent license code, do the following steps and select the appropriate option.

1. From the Axis camera's setup screen, and click on the Apps menu. Then click on the VaxOCR Genesis application. **Take note of the Axis product serial number that appears in the License Activation section.**
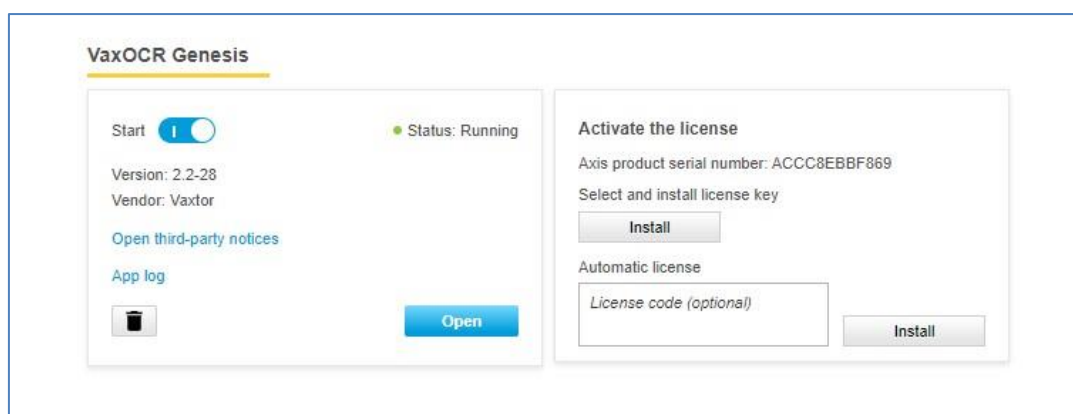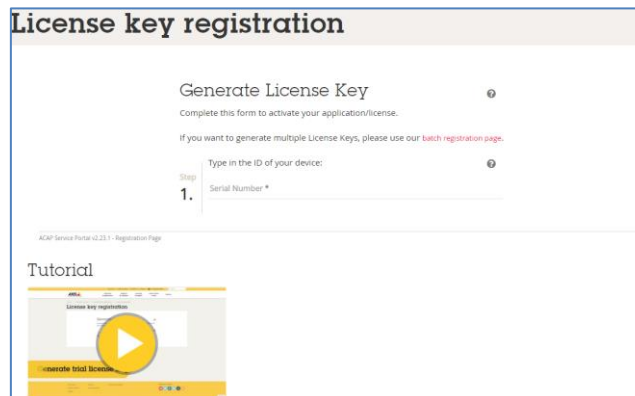
Axis camera setup: Apps > VaxOCR Genesis On Camera > License

2. Using your browser, go to the Axis website: .
    If you already are an Axis user, just log in. Otherwise, register a new account.

Axis website: Log in to download a trial license
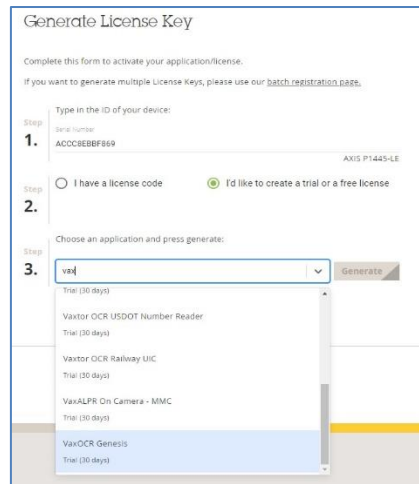
3. In the License key registration web page, do the following:
    ➢ Type in the ID (Axis product serial number) of your camera.

Axis website: Enter the camera serial number

To generate a trial license

➢ Select the corresponding radio button. Select VaxOCR Genesis as the application name and press the <u>Generate</u> button.

Axis website: Generate a trial license key
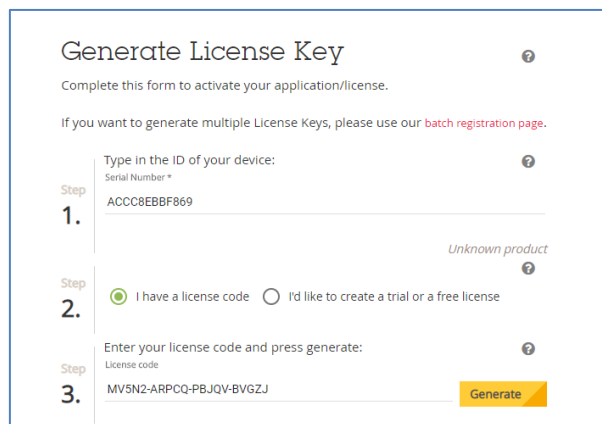
➢ Download the trial license key to your PC.

Axis website: Download trial license key
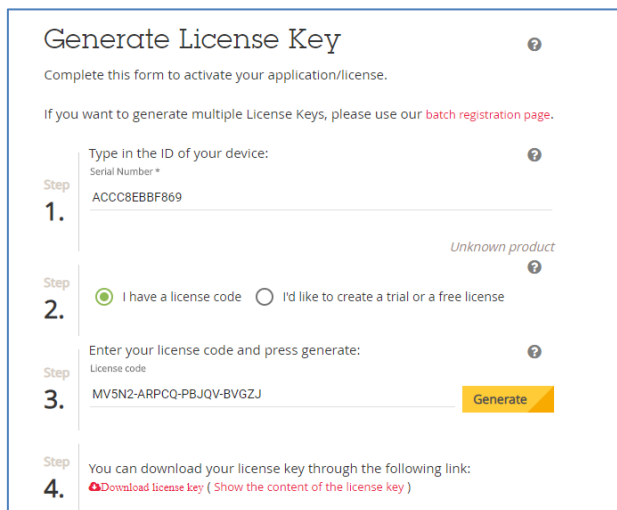
To generate a permanent license

➢ To purchase your permanent license, contact Vaxtor and send us your Product Serial number along with your order. When this process is completed, you will be sent a License code.

➢ Select the corresponding radio button ('I have a license code') and enter your code and press the <u>Generate</u> button.
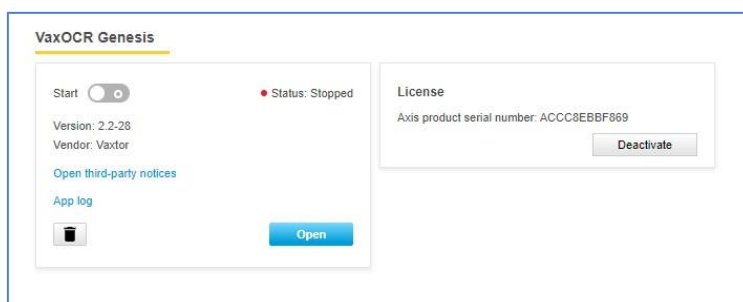
Axis website: Generate a permanent license key

➢ Download the permanent license key using the link shown in red.

Axis website: Download license key

4. Now that you have the license key, go back to the Axis camera's setup and click on the Apps menu. Click on the VaxOCR Genesis On Camera > and in the '<u>Activate the License</u>' section click 'Install'.

5. A file menu will open appear select 'License option. Click on the <u>Select file</u> button and select the license key file you have just downloaded. Click 'Open'.

6. Next click on the <u>Install</u> button.

7. The permanent license should now be installed correctly.

Axis camera setup: Apps > VaxOCR Genesis On Camera > License

8.3 Restart the Axis Camera

Once the VaxOCR Genesis On Camera software is installed and the license key is uploaded, you should restart the Axis Camera. Do this by selecting the 'System' tab and click on the 'Maintenance' icon.   Select the '**Restart'** button.
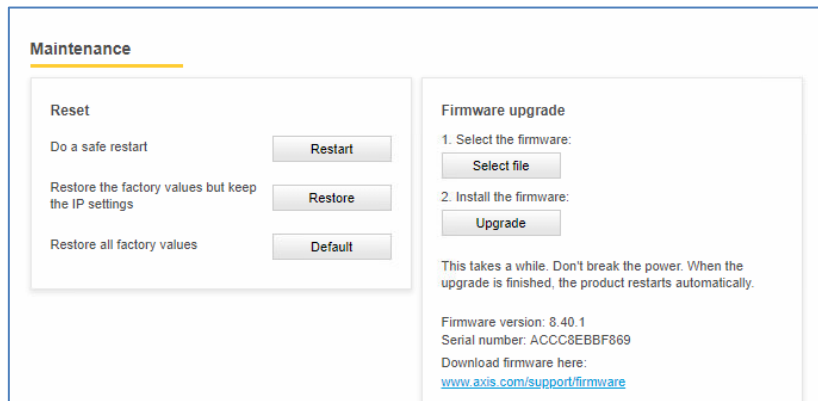
Axis camera setup: System Tab > Maintenance > Restart

8.4 Starting the VaxOCR Genesis software

To start the VaxOCR Genesis On Camera software, select the Axis camera's Settings, click on the Apps Tab and select the VaxOCR Genesis App. Use the Start Slider to start the application. The Status should change to 'Running'.
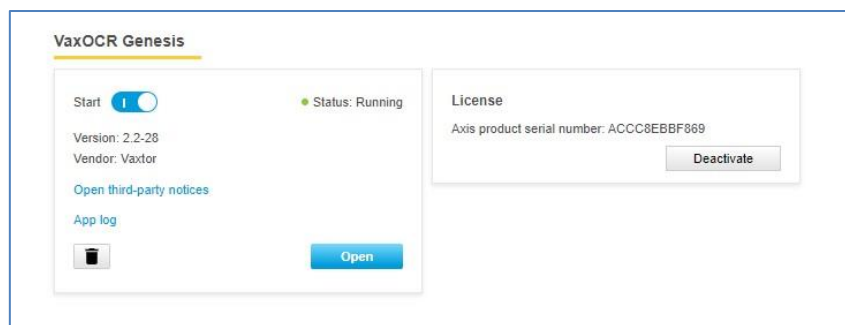
Axis camera setup: Apps > VaxOCR Genesis On Camera

9. Configuring the VaxOCR Genesis Application

Once the software is running you can configure the VaxOCR Genesis software by clicking on the blue Open button.
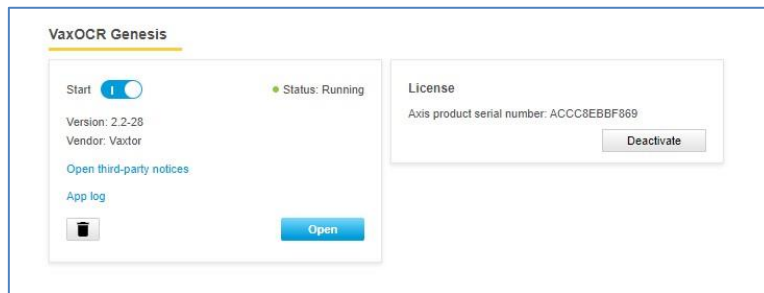
Axis camera setup: Apps > VaxOCR Genesis On Camera

9.1 System Messages

At this point the software will check that some basic camera settings are correct and display any warnings. Note that in order for the software to check for the latest version of the application an internet connection should be available and the DNS settings configured. See Section on setting a DNS server at the end of this manual to see how to do this.

If there are any messages a warning symbol will appear at the bottom right of the screen. This may be clicked at any time to show the current messages.
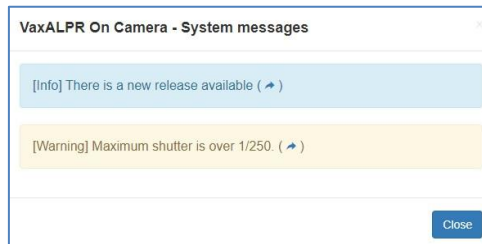
If the warnings are more serious a red symbol will appear:

Warnings include:

- Checking for the latest version of software on the Vaxtor website. *(This assumes that the camera is connected to the internet)*
- Shutter speed that is too low (slower than 1/250th sec) (ok for non-moving objects)
- WDR (Wide Dynamic Range) is switched on. (Okay for most non-IR scenarios)
- Auto Rotation is enabled
- Gain is over 12db
- Database has been enabled but the SD Card is full or write protected
- Etc.

If there is a newer release available and you wish to install it, follow the link in the message to the Vaxtor website and download the latest version. Once you have downloaded the latest version (or received a release from Vaxtor), then return to the Axis Apps page and stop the App running. **DO NOT DELETE THE APP!**

If you do then you will have to re-license it.

Click the Add + icon, browse for your new download and click install. This will upgrade to the latest version without having to re-license. Start the App and when running click on Open. You will see the version number displayed at the top the screen.
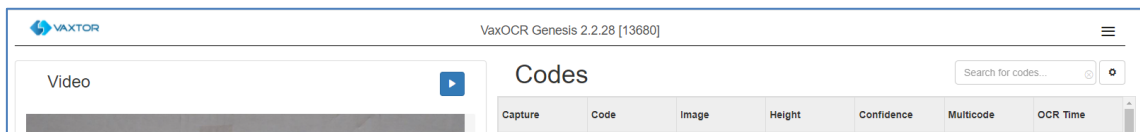
9.2 VaxOCR Genesis Camera user interface

This will open a new window with the VaxOCR Genesis main interface.
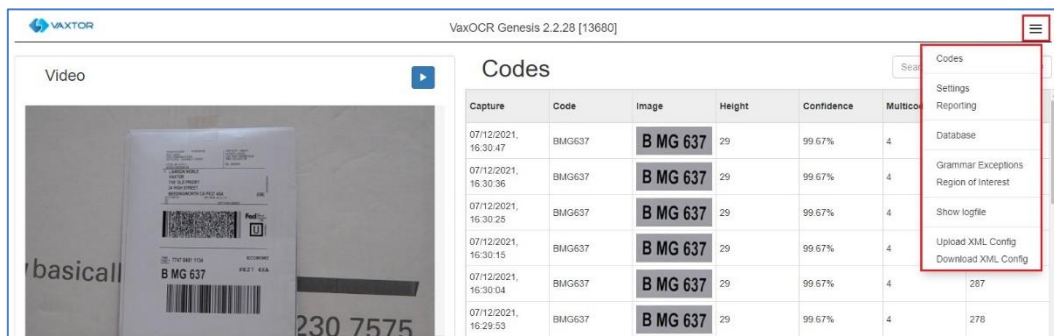
VaxOCR Genesis interface

The icon in the top right corner reveals the options menu.

VaxOCR Genesis includes the following options:

- Codes: To display a live feed of all the most recent text read (codes)
- Settings: To configure the VaxOCR Genesis software
- Reporting: To configure the various reporting options.
- Database: To review and search the list of recorded codes (if configured)
- Grammar Exceptions: To specify a list of codes to be corrected that have been damaged or badly printed
- Region of Interest: To add/edit ROIs to include or exclude in the OCR analysis.
- Show logfile: Displays the internal logfile to show tech details of reads etc.
- Upload XML Config: To import the VaxOCR Genesis settings from a XML file.
- Download XML Config: To export the VaxOCR Genesis settings to a XML file.

9.3 VaxOCR Genesis not running

If the VaxOCR Genesis application is not running correctly, a message will pop up.

If the software is not able to run correctly, please ensure that:

- The date and time of the camera is set correctly.
- A valid license has been uploaded and activated.
- The previous version was uninstalled before installing a new one. If this was not performed the log file in the camera may contain an error message requiring the software to be reinstalled. In this case
  - Uninstall the current version by stopping the software and then clicking the Bin icon below the App Log button.
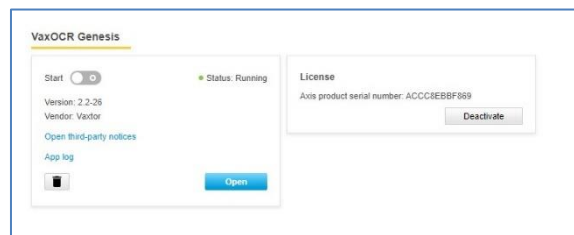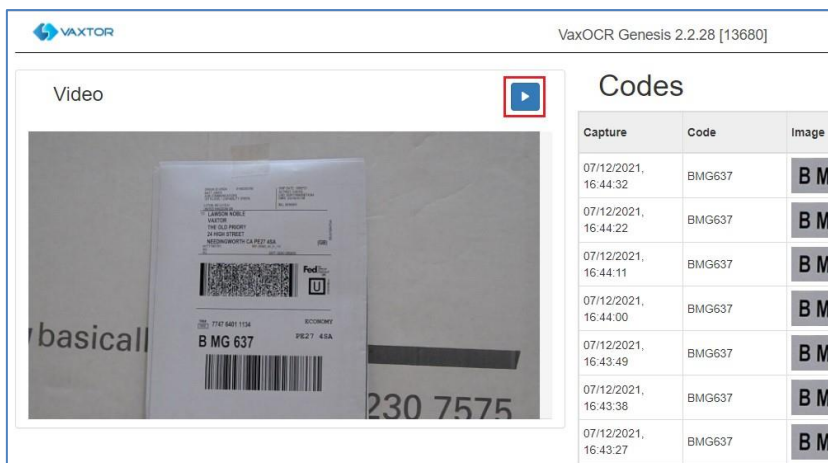
  - Shutdown and restart the camera.
  - Reinstall the latest version.

9.4 Live   Video   Button

When the GUI starts, a single image is grabbed from the camera and frozen for you to select from the menu or view captured codes. Press the Play icon to start the live video.

Note that if you are using say a 4g connection to the camera, then by viewing a live image in a browser window you will be streaming data over your connection to your PC which you may be charged for.

10. VaxOCR Genesis Settings

In the **VaxOCR Setting page** it is possible to configure all of the OCR parameters. The settings are divided into several different sections and a Summary section.
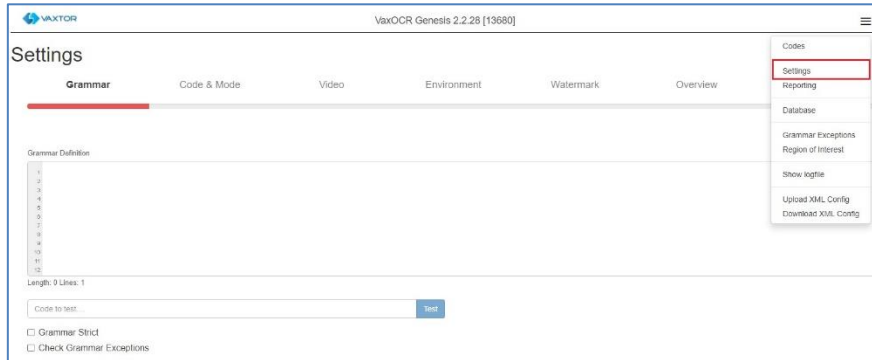
To move between the steps, use the blue previous/next buttons or click on the headers over the red progress bar.
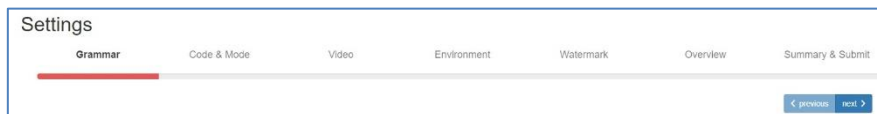
The last step, *Submit*, will save all of the settings to the camera's memory.

Remember to do this after making any changes!

10.1 VaxOCR Genesis Settings: Grammar

In this section you can define very complex grammar rules for reading multi-line text strings. (At present up to 3 lines). These rules can be set up to find particular strings (e.g. 17 alphanumerics or 5 vowels) or change certain characters (such as 1 to I).

For example, you might have a complex alphanumeric sequence (in this example 17 characters associated with a QR code):

In this case the code contains both letters and digits and so grammar rules can be used to specify for example that the code is always formed thus:

DLLDLDLLDLLDDDDD   where D=Digit and L=Alphabetic (Letter)

So, the next to last character shown in the QR code image above should always be interpreted as a numeric zero and not an alphabetic O.

Firstly, you specify what characters are to be replaced followed by the grammar definition. Special characters are used to mark character positions for replacement and / or deletion.

Simple example

If a character string is something like ABC123 – (so 3 letters followed by 3 numbers and you want to set a rule that if the first character is a 0 (zero) then replace with an O (oh) then the two lines of grammar required could be:

^0%L%L%L%D%D%D~^O%L%L%D%D%D
%L%L%L%D%D%D

..where the first line specifies the replacement and the second the basic syntax or grammar i.e. the string you are looking for.
There are special characters to start at the beginning or end of a string and you can even define variables to represent a group of alphanumerics or words to be replaced.

A comprehensive guide to the grammar and its use can be found towards the back of this manual here.   The guide contains several complex examples.

Enter the grammar rules and **definition** in the main dialogue box. There can be as many lines as you will need.

Code to test

Once the grammar rules have been defined you can test them here by entering a code and pressing the Test button:
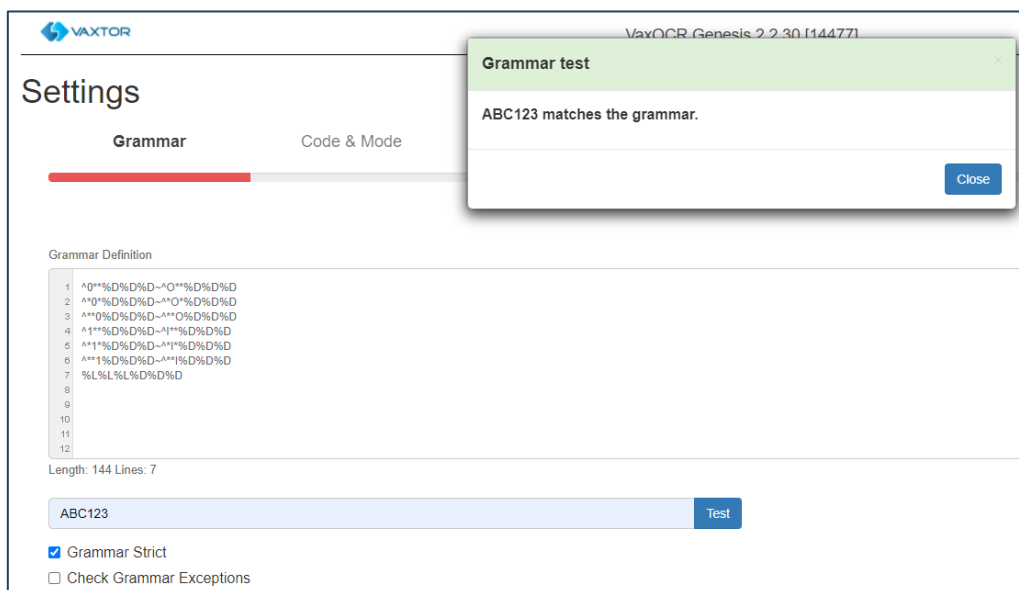
A dialogue box will appear confirming if the entered text matches the defined grammar or not.

Grammar Strict

- Select this checkbox to force the Engine to only use the grammar defined by you. Text that does not match these rules will **not** be reported. This is the recommended option for using VaxOCR Genesis where exact matches are required.

- Do not select this checkbox when you want to report ALL text found in the field of view.

Check Grammar exceptions

Default OFF. This feature is used to correct any text that has been damaged or misprinted. For example, an identification number on the back of a vehicle is damaged and is always read as "TRAILER 1000H" but the H is actually two 1s with a scratch between making them appear on this particular vehicle as H. An exception can be set up to always report this code correctly: 'TRAILER 100011'

See later section on VaxOCR Grammar Exceptions to set up text to be replaced/corrected.

10.2 Code & Mode

The **Codes** section of this page allows you to specify the type of print to be analyzed (dark text on a light background or vice versa):

This section is where you specify the minimum and maximum number of characters to scan for.   So, if you are looking to read stock codes which could be say ABC1 up to ABC9999 – then you would specify 4-7 as the number of characters range.

IMPORTANT: In order to save recorded codes in the camera's storage for later retrieval or viewing, you must install and configure an appropriate SD card in the camera. There is a Storage icon in the Axis main setting area where you can also setup shared network storage.

The system does not check for available space on the SD card and if it becomes full the database functions will stop working.

Mode

Generate database

- To generate an on-board database (log file) of detected codes, select the ☑ *'Generate Database'* checkbox. A maximum of 100,000 records may be stored in the database.

Store database images

- To also store images of each code read, select the ☑ *'Store database images?'* checkbox. These images are automatically deleted when the matching container code is deleted.

Retry notifications

- Select this checkbox ☑ to retry the sending of any notifications if any fail, for example due to a comms problem.
- You may then specify a retry period in seconds.
  See VaxOCR Reporting later in this manual.

Use low coverage mode

- Select this checkbox ☑ if your camera is remote and the communication links (Wi-Fi or 4g for example) are constantly dropping out. When selected, events are not sent in real time to any configured Back Office or recipient (See Reporting options later in this manual). In very bad conditions this would cause a backlog of events being constantly tried.
  Instead, they are retransmitted after a longer interval reducing the chance of an ever-increasing backlog.

  Note this should NOT be used when using UTMC protocol or when using the system for access control where real time events are essential.

How retries work

Normally the transfer process takes approximately 100ms without image, and 300ms with image. Even with the low coverage mode active, if the response from the server takes more than 5 seconds, you will get a timeout error on the camera, BUT this does not mean the data hasn't arrived at the endpoint.

Usually this is caused by the server receiving the request and processing the data **before** sending the data received acknowledgement to the client (the camera). The data is already on the server, but the camera only waits 5 seconds for the response. This can cause the same data to be re-sent as the camera does not receive the OK response and the entry in the camera database is still marked as unsent (or not received).

Check your endpoint software (back office) and ensure that responses are sent to the camera **immediately** after receiving the data before processing the data. Contact Vaxtor for further information.

Maximum database entries (1 to 100,000)

- Next set the maximum database size to the desired level.   When this limit is reached the oldest records will be overwritten. Records can be written to the camera's internal SD card (if present) or a network share location if configured.

(See Reporting section – Write Result).
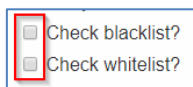
*Note that if you are using a small SD card then the card may to become full before this circular buffer limit is reached and so **no** new reads will be written to the card and so you should reduce this buffer size accordingly. There is no definite standard record size as this depends on video resolution, the complexity of the image, the jpeg compression factor used etc. As a rough guide a 32GB SD card would store approximately 80,000 reads at 1920 horizontal pixels..*

Generate log on the SD

- Select this option to write log files to the Axis camera's internal SD card (if fitted).
  Note that the Application should be restarted after this has been enabled.

Black / White list activation

Check blacklist
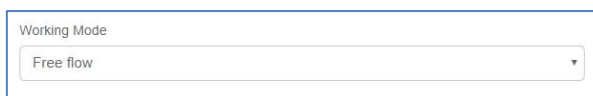
- Select this checkbox ☑ to enable code checking against a predefined Blacklist.
  (see: VaxOCR Blacklists and Whitelists later in this manual)

Check whitelist

- Select this checkbox ☑ to enable code checking against a predefined Whitelist.

Note that Black and White lists can be stored centrally on Vaxtor's Back Office "Helix" and automatically synchronized with all connected cameras.

Working mode

- Select the appropriate option from the drop-down list. There are two options:
  - *Free flow*: The system continuously analyzes the video and reports codes when detected.
  - *Signaled*: The system only analyzes the video when the defined port changes its state from disabled to enabled.

- If **Working Mode** selected is set to '*Signaled*', a port must be specified (physical or virtual) and a delay can be set. This causes the App to wait after receiving the trigger before analyzing the frame. See below:

- Specify whether the selected **Port** is virtual or not.
- Specify if only one code result is to be sent.
  This applies to images that contain multiple codes, - in this case the App will return the most confident code read.
- If when triggered, no code is found in the field of view, then you can specify if the word 'NONE' should be transmitted at this point.

Triggering a read in Signaled Mode

In signaled mode, if the software cannot find any text that fits the grammar definitions then as seen above it can return the code as "**NONE**" along with all the normal metadata including the id of the signalling source.

There are three ways of triggering the software:

1. **An HTTP request to the App.**
   Write to the address of the camera as follows:
   http://CAMERA_IP/local/Vaxreader/trigger.cgi?id=12345AbcdE
   ..where `id` is optional and can be any string.   This will trigger the LPR and links the image with the id. This id will be stored in the codes table in the database and it is included in the Vaxtor protocol TCP/IP message as **$signalid$**
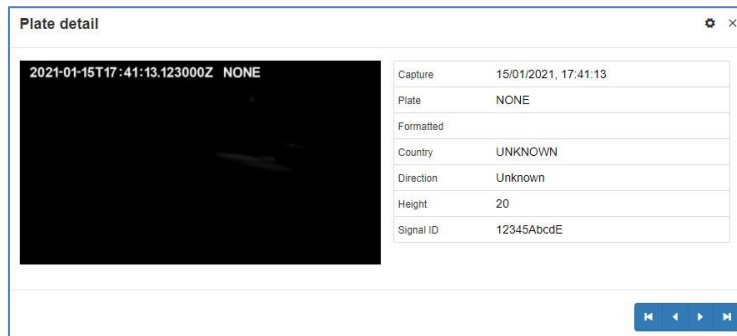
2. **An electrical signal received via one of the camera's I/O ports**
   A physical port can be configured to detect an electrical pulse. See Port below.

3. **A virtual port trigger received from the Axis camera.**

   A remote program – or an internal event can call, for example:
   http://camera_ip/axis-cgi/io/virtualinput.cgi?action=6:/500

   This will trigger virtual port 1 for 500ms.
   (6 is virtual port 1, 7 is virtual port 2)

Port

The port is the camera port which can be a physical input port (usually 1 or 2 depending on the camera model and the number of ports available), or it could be a virtual port – which could be 6 or 7. *(6 is virtual port 1, 7 is virtual port 2).*

10.3 VaxOCR Genesis: Video Options
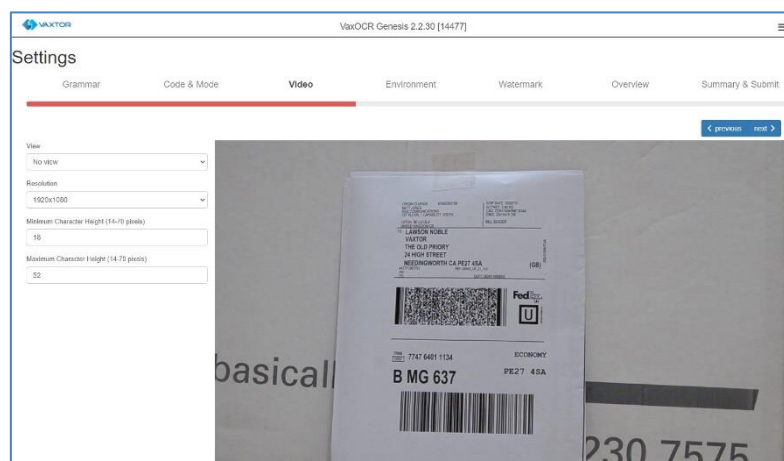
This section displays real-time video based on the current settings.
When some parameters are edited, the changes are immediately reflected in the video stream.

View

- Select a View area from any available in the drop-down list.
  (These are previously set up in the main Axis camera settings. You may setup several View areas from the same camera)
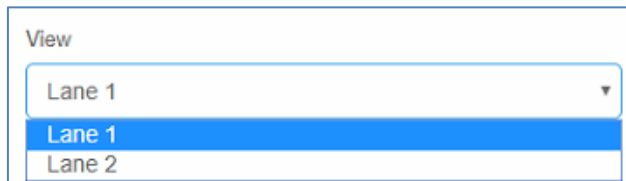
Resolution

- Select the desired *Resolution* from the drop-down list. Any changes will immediately be shown on the live display.
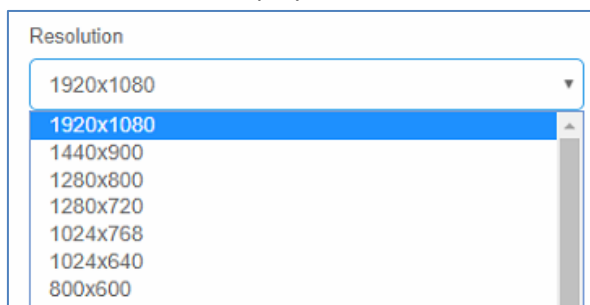
Minimum Character Height (14-70 pixels)

This is the minimum height that a code's characters should be before being read. If the lens (zoom) is setup correctly then the characters should be about 20-30 pixels high in the area of the field of view where they should be read. Small characters will cause misreads.

- Set the minimum height of the code's characters in pixels.

NOTE: The recommended difference between the min and max heights is about 10 pixels.

Maximum Character Height (14-70 pixels)

- Set the maximum height of the code's characters in pixels.

Same Code Delay (seconds)

Same Code Delay (seconds)

10

- Set the number of seconds that should elapse before reading the same code twice. This is to prevent multiple reporting of the same code in situations when the code or text is moving slowly or is stationary. For example, if a package stops on a conveyor belt and the code is reported but the package doesn't move for 40 seconds, then this delay should be set to say 60 seconds or more to prevent a duplicate read.

NOTE: When using signaled (triggered) mode, it is recommended that you set this delay to 0 seconds.

Code reading timing options

Multicode timeout (0-10000 milliseconds)

1000

Multicode minimum number of occurrences

2

Multicode maximum number of occurrences

5

Code reported

Middle capture

Multicode timeout (0-1000 milliseconds)

Multicode timeout (0-10000 milliseconds)

1000

- Set the number of milliseconds that the engine should spend analyzing a code
(1000 milliseconds = 1 second)

In free-flow mode the engine continuously analyses video frames and reads and reports codes. It makes a final decision on the code read after an interval of time - the Multicode timeout period. There is a dedicated time counter for every code read which starts counting after the first read. When it reaches the preset timeout it stops, checks the

number of samples read of the same code and returns the "best" result.

If an instantaneous code is not needed then set this timer to say 1500ms (1.5 seconds) so that the engine continues to look for the same code to read again for as long as possible. Note that if a new code is spotted during this time, the old one will be reported and a new code-trace started.

We call the number of times the same code has been read within the multicode timeout period the **multicode rate**. Several reads of each code are good and produce better results.

Multicode minimum number of occurrences

Multicode minimum number of occurrences
2

- Set the minimum number of times that a code should be read within the Timeout period to be considered a valid code.

Multicode maximum number of occurrences

Multicode maximum number of occurrences
5

- Set the maximum number of times that a code should be read before being reported (this may happen before the timeout).

Code reported

Code reported
Middle capture

- Select which code image should be saved from the drop-down list:
  - *First capture.*
  - *Middle capture.*
  - *Last capture*
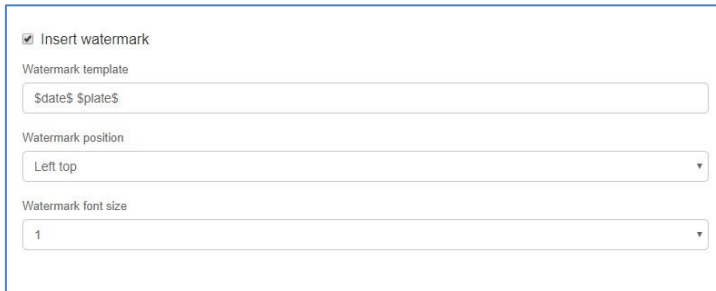
A code is normally read several times as it passes through the camera's field of view. You may want to use the largest (Last) image for oncoming traffic & the First image for vehicles moving away from the camera.

10.3.2 VaxOCR Genesis Settings: Watermark

The Axis camera has a built in Overlay option to overlay text onto the video stream including the last read code details and other dynamic text.

See the VaxOCR On Camera Axis Software Developer's Guide for more details and see the Reporting section later in this manual.

Inserting a watermark using Reporting is useful when video is being sent to a VMS such as Milestone or Axis's own and the overlay text is written onto the video stream. However, when still images are transmitted to Vaxtor's Helix software or some other device using one of the other reporting options then the software has no knowledge of the video stream and so this Watermark option should be used which will write for example the code text and date onto the still image being sent.

The watermark template field allows you to insert dynamic text that will be overlaid onto the still image of the captured code. Choose from the following variables:

- **$date$**: Timestamp in ISO8601 format
- **$code$**: Text or code number
- **tag**: Unique hash for this code number. Same code number will always give the same tag. Format based on UTMC algorithm.
- **$codeutf8$**: Code number in utf8 format.
- **$country$**: Full country of origin name.
- **$countrycode$**: 3 letter country code.
- **$state$**: Code State for USA.
- **$category$**: Code category for countries that support it.
- **$blacklist$**: Description on the blacklist linked to the code number.
- **$whitelist$**: Description on the whitelist linked to the code number.
- **$ifblacklist$ .... $ifblacklist$**: If the code is on the blacklist, the text in the 'if clause' will be displayed.
- **$ifwhitelist$ .... $ifwhitelist$**: If the code is on the whitelist, the text in the 'if clause' will be displayed.
- **$ifnolist$**...**$ifnolist$**: If the code is not on a list, the test in the 'if clause' will be displayed.
- **$confidence$**: Global confidence (0-100).
- **$charheight$**: Average charheight (pixels).
- **$processingtime$**: Processing time in milliseconds.
- **$left$**: Left coordinate for the code on the image (pixels).
- **top**: Top coordinate for the code on the image (pixels).
- **$right$**: Right coordinate for the code on the image (pixels).
- **$bottom$**: Bottom coordinate for the code on the image (pixels).
- **$absoluteleft$**: Code left position based on the total image width (0-1).

- **$absolutetop$**: Code top position based on the total image height (0-1).
- **$absoluteright$**: Code right position based on the total image width (0-1).
- **$absolutebottom$**: Code bottom position based on the total image height (0-1).
- **$width$**: OCR image width.
- **$height$**: OCR image height.
- **ip**: Camera IP address.
- **$roiid$**: Roi ID where the code number is found.
- **$speed$**: Vehicle speed (Km/h).
- **$multicode$**: Amount of times that the code has been read before reporting.
- **$signaled$**: True if the read was caused by a trigger.
- **id**: Database ID for this read.
- **$direction$**: Enumerate with the vehicle direction (0: Unknown, 1: Towards, 2: Away, 3: Stopped)
- **$directionstr$**: String with the vehicle direction.
- **$safedate$**: Date in format %Y%m%d_%H%M%S in the camera time zone (Useful for filenames).
- **$localdate$**: Date in format %d/%m/%Y in the camera time zone
- **$localtime$**: Date in format %H:%M:%S in the camera time zone.
- **$imageid$**: Signal ID in case of a trigger read.
- **$codeimage$**: Code crop JPEG image encoded in base64.
- **$codejpegsize$**: JPEG size in bytes.
- **$overviewimage$**: Overview JPEG image encoded in base64.
- **$overviewjpegsize$**: JPEG size in bytes.
- **$epoch$**: Unix epoch (seconds).
- **$utcdate$**: Will report the date at ISO8601 format but always in UTC. (2020-12-31T16:11:30.000Z)
- **etx**: End transmission character (03)
- **stx**: Start transmission character (02)

In the example below we are using the $code$ and $date$ fields.

($code$ is a variable taken from our ALPR software and is the text or code read)

Next select the position of the watermark from the four options available and finally select the font size required.   All saved images will now have this information burnt into the still images of the code capture.

10.3.3 VaxOCR Genesis Settings: JPEG Compression

☐ Perform report crop to 640x480

JPEG quality (1 to 100)

80

Maximum JPEG size (0 is unlimited)

0

- Select the required compression ratio for the saved images. The lower the number, the higher the compression ratio (and smaller the image size) but the quality of images will be lower. 80 is a good compromise.
- Set a maximum size (in Bytes) if your Back Office software has size limitations.
- In the case of a restricted size, you should use the 'Perform crop to 640x480' setting. This will crop an area around the code read to apply the compression to. This is better than compressing the whole image which will result in a very low-quality result!

10.3.4 VaxOCR Settings: Overview Setup

The Overview feature is used when deploying two cameras: one for the OCR and one for another field of view. A second camera and its contextual image can be captured and be associated with the code read. Typically, this second camera is zoomed out slightly to capture the entire scene and show the complete object being read.

Here we can specify the URL of a secondary Axis camera which must have a separate ACAP application installed called "VaxOverview" (available for a nominal charge from Vaxtor) that will serve images to the primary Axis camera performing the OCR.

The file for ARTPEC 6/7 based cameras is called: **Overview_1_0_armv7hf.eap**
and for ARTPEC 5 it is called: **Overview_1_0_mipsisa32r2el.eap**

(As this is not processor intensive and it is okay to use an ARTPEC 5 based camera if available)
Now every time a code read is performed by the primary Axis OCR camera, it requests a single frame (image) from the secondary Axis Overview camera with the exact same timestamp as the code read.
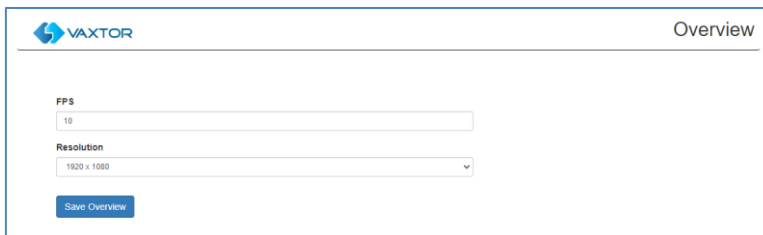
Note: It is very important that both cameras are NTP synchronized.

The OCR camera will then send the overview image with the code read if requested to Helix or other third-party applications.

There are variables $overviewimage$ and $overviewimagejpegsize$ to specify this information.

When the Overview App is running you can set the frame rate and resolution of the images to be captured and sent to the primary OCR camera:

Overview URL

- Setup the URL to access the Axis camera to be used as the overview camera.
- The address should be: **http://<cameraip>/local/Overview**

  e.g. http://192.168.0.99/local/Overview

Overview User

- Enter the user name with admin rights on the Overview camera. E.g. 'root'

Overview Password

- Enter the password for the Overview user. E.g. 'pass'

Note that if "Generate database" and "Store database images" have been ticked in the Mode section, then both images (The OCR image and the associated overview image) will be stored in the OCR camera database.

Application note:

It is possible to run the Overview App on the same camera as the OCR App. In this case the overview image can be set to a different resolution to that used for the OCR. One use of this is when using a very high-resolution Axis camera, e.g. a 4k x 3k model. You would normally not want or need to perform the OCR at the highest resolution as this would cause the software to take longer than necessary to find and process codes; you should always operate at the minimum resolution necessary using the guidelines described at the start of this manual. However, once a code is found you could use the VaxOverview App running on the same camera to also save a very high-resolution image of the scene for later analysis or reference.

Another time this would be useful is when you are short of processing power. In this case you might use an ROI to minimize the field of view and by selecting "Crop ROI" a rectangle will be formed around your ROI and the image converted to monochrome to speed up the OCR by quite a lot.
In this case you could use the VaxOverview App to save / send the full color image back to the server or Back Office application.
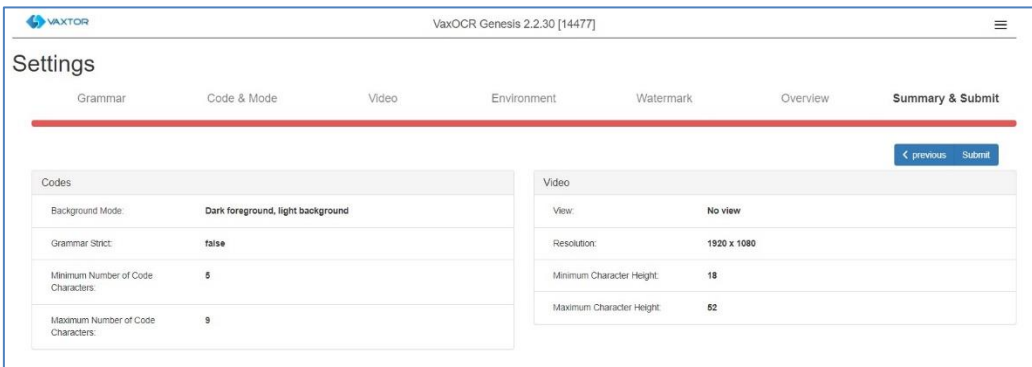
When using the VaxOverview App on the same camera you could use the IP address:
http://127.0.0.1/local/Overview

VaxOCR Genesis: Submit changes

Submit configuration

1. To save all of the OCR settings, click the `Submit` button.

2. Wait for the confirmation (or error) message.
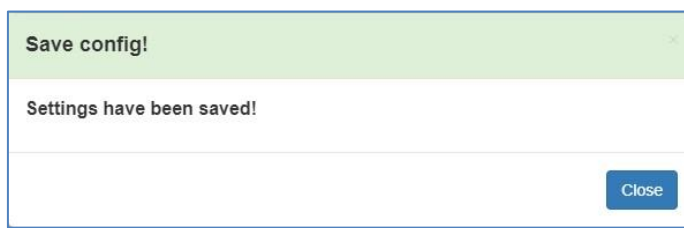
IMPORTANT: To avoid unexpected problems, it is recommended that you backup the current configuration to the Axis camera by downloading the configuration XML file (see: Download XML Config section later in this manual).

10.4 VaxOCR: Codes Database

The last 20 code reads are stored in the camera's standard memory and are displayed when the Codes menu is selected.
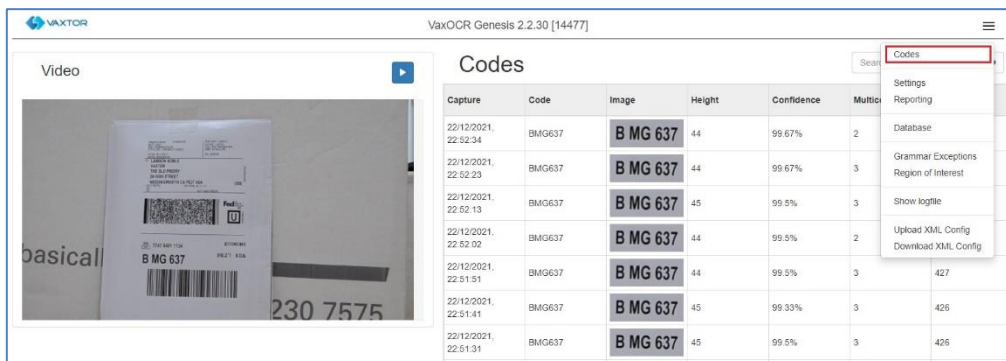
If the camera has a SD card installed, it is possible to store the OCR activity in a local database which can store up to 100,000 records. To access this, click on **Database**.

Once this limit is reached, new code reads will replace the oldest ones. There is a Pause / Play button at the bottom of the screen for preventing any new codes being added to the list for a short period.   Pressing Play once more catches up any cached reads.
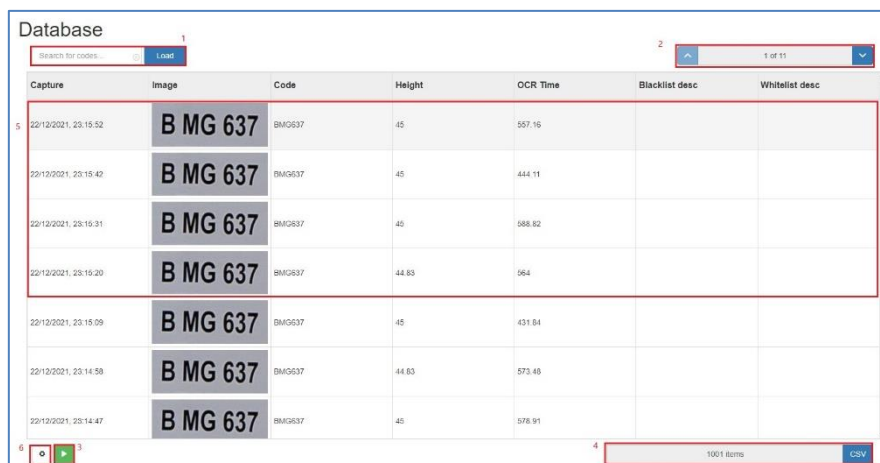
The Database screen comprises:
- (1) Search and Load area
- (2) Page display control
- (3) Play / Pause updating the database with new reads
- (4) Total items stored and CSV download
- (5) Main list of codes read
- (6) Headings configuration

Code details

1. To show item details, click on a code record and a new window appears with the read details.
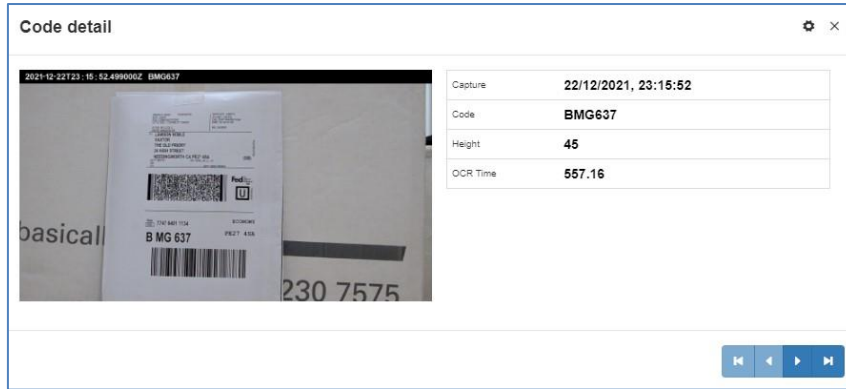
Page Control

If there are more than 100 stored reads, the camera will paginate the results.

1. Use the Page Control box to navigate through the pages

Use the UP and DOWN buttons to scroll 100 codes at a time – or click on the central part of the button (in this case on 2/11) and enter the target page directly and click on GoTo:

Search and Load Codes

Load Codes

1. To load all the detected codes stored in camera, keep the Search input zone empty and click the [Load] button.
   This will refresh the list with the latest captures.
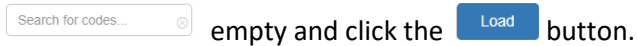
Search for Codes

1. To search for a specific code or partial code stored in camera, enter the characters in the Search box and click the [Search] button. Use the symbol "%" as a wildcard character.

2. To clear search criteria, click ⊗ button inside the Search window zone, and click the [Load] button.
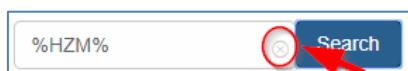
Download the Code list.

You can download the current list by clicking on the CSV button:

8 items	CSV
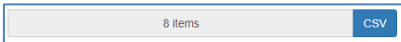
button.

The resulting .csv file will be saved in your Downloads folder and appears as follows:

```
d;plate_number;plate_origin;confidence;taken_on;is_blacklist;blacklist_description;is_whitelist;whitelist_description;character_height;character_confidence;processing_time;multiplate_rate;signaled;roi_id;left;top;right;bottom;error;state;num_rows;direction
89647;BMG637;Genesis;99.5;2021-12-22T23:26:44.000Z;false;;false;;44.833;100;550.296;2;false;1;569;735;817;827;false;;1;3
89646;BMG637;Genesis;99.5;2021-12-22T23:26:33.000Z;false;;false;;44.833;100;545.864;3;false;1;569;735;817;827;false;;1;3
89645;BMG637;Genesis;99.667;2021-12-22T23:26:21.000Z;false;;false;;45;100;549.157;3;false;1;569;735;817;827;false;;1;2
89644;BMG637;Genesis;99.667;2021-12-22T23:26:10.000Z;false;;false;;44.833;100;440.066;2;false;1;569;735;817;827;false;;1;3
```

The first row contains the field headers.

NOTE: In this example only a few items were in the search list which were then downloaded successfully. If you need to download the full database, then this must be downloaded page by page, 100 records at a time.

Do this by Pausing the live reads ▶ and then selecting each page in turn and downloading.

If you need to see all of the camera reads then it is recommended that you send all the code reads as they happen to a back office such as Helix.   The program contains many reporting protocols and methods - see the Reporting section.

10.5 VaxOCR Region of Interest

A Region of Interest (ROI), sometimes known as the Crop Zone, is used to define an area within the video frame where the OCR analytics takes place. The user can define a polygon and choose whether the area to look for codes Inside or Outside this region. The user can set multiple ROIs in complex situations although this is rare.

Using an ROI can decrease OCR processing time and also reduce false positives.
So, if the camera is looking across a large area, the ROI can be used to limit the OCR to the area where the codes are always seen. In this case in the bottom half of the field of view - thus reducing the processor load.

If say an item in the scene is within the camera's field of view and keeps getting mistaken for a code, then these false positives can be eliminated by creating a crop zone to exclude this part of the image.
Each ROI must be given a unique numeric Identifier from the dropdown list.
Note that the code must be in or out the ROI to pass the test.
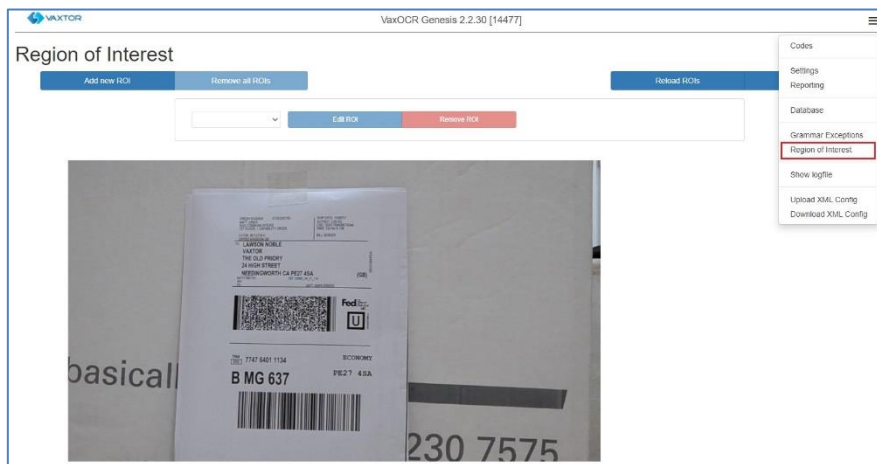
IMPORTANT: *ROIs con be configured to either include the areas defined from the OCR – or exclude them. If multiple ROIs are added they must all be of the same type.*

VaxOCR ROI: Add ROIs

1. To add a new ROI, click the main [Add new ROI] button:
2. Then, use the drop-down to allocate an ID number to the ROI that you are adding and if this is the first ROI, then specify the ROI Type between: *Included* or *Excluded.*
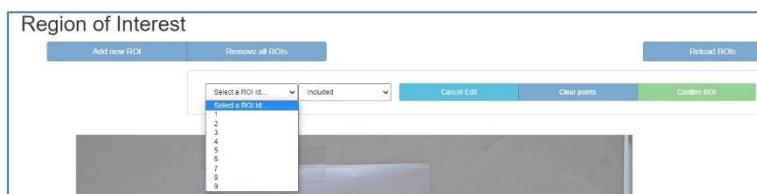
3. Draw points:
   a. Add points: Click on the live image to add new points to define the polygon.
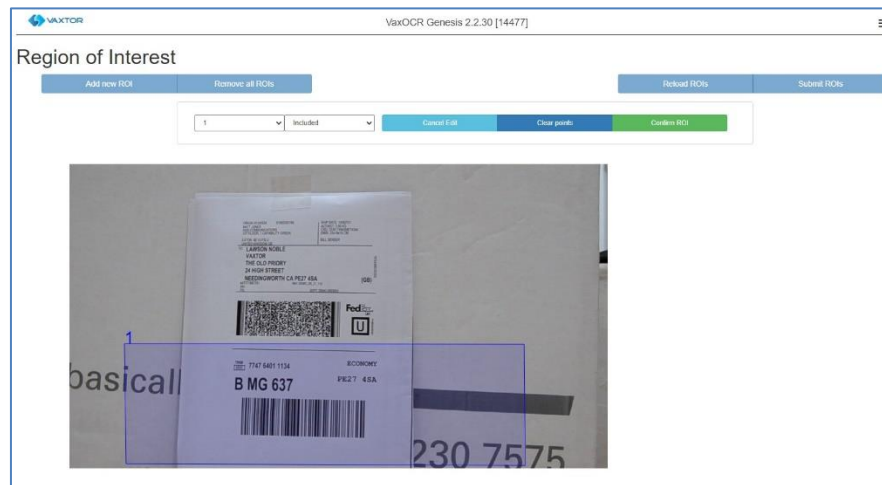
NOTE: Each ROI must have at least 3 points but can also be quite complex

   b. To start again, click on the [Clear points] button.

   c. To cancel the new ROI, click [Cancel Edit] button.

   d. When you are satisfied with the shape click the [Confirm ROI] button.

4. Click [Add new ROI] to add more ROIs as required remembering to select a new ID number.
5. ROIs are not stored on the camera until changes are submitted.
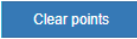
VaxOCR ROI: Remove ROIS

1. To remove all of the ROIs click [Remove all ROIs] button.

NOTE: This only deletes them in the local web interface. If they have been saved to the camera then you will need to Submit ROIs once more.

VaxOCR ROI: Edit an ROI
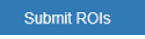
1. To edit an existing ROI, select the *ROI Id* from the list and click [Edit ROI] button:

2. Move any points as required:

a. Add an extra point to last point added by moving the cursor and mouse click.

b. Or, clear all existing points [Clear points] and start again.

3. To confirm changes by clicking the [Confirm ROI] button.

4. To reject any changes, click the [Cancel Edit] button.

VaxOCR ROI: Save changes
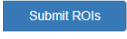
Submit current ROIs

Once the ROIs have been setup, they **must** be saved into memory in the Axis camera.
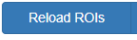
- To save all ROIs, Click on the [Submit ROIs] button and wait for the confirmation message.

Note: Once deleted, an ROI cannot be recovered. To avoid unexpected problems, it is recommended that you periodically backup the ROI configuration by downloading the current configuration XML file
(see: Download XML Config section later in this manual).

Delete all the current saved ROIs in the Camera

- Delete all of the ROIs individually and then click the [Submit ROIs] button.
- A confirmation message will appear. Accept to delete all of the stored ROIs and wait for the confirmation message.

VaxOCR ROI: Reload ROIs

1. To reload *ROIs* from the camera into the web interface for editing, click the [Reload ROIs] button.

10.6   VaxOCR Reporting

VaxOCR Genesis is able to output all code reads in real time using a variety of standard protocols to that the code reads can be accepted remotely by a variety of programs including Vaxtor's powerful Back Office - Helix, which can accept and store code reads in real time from hundreds of Axis cameras.
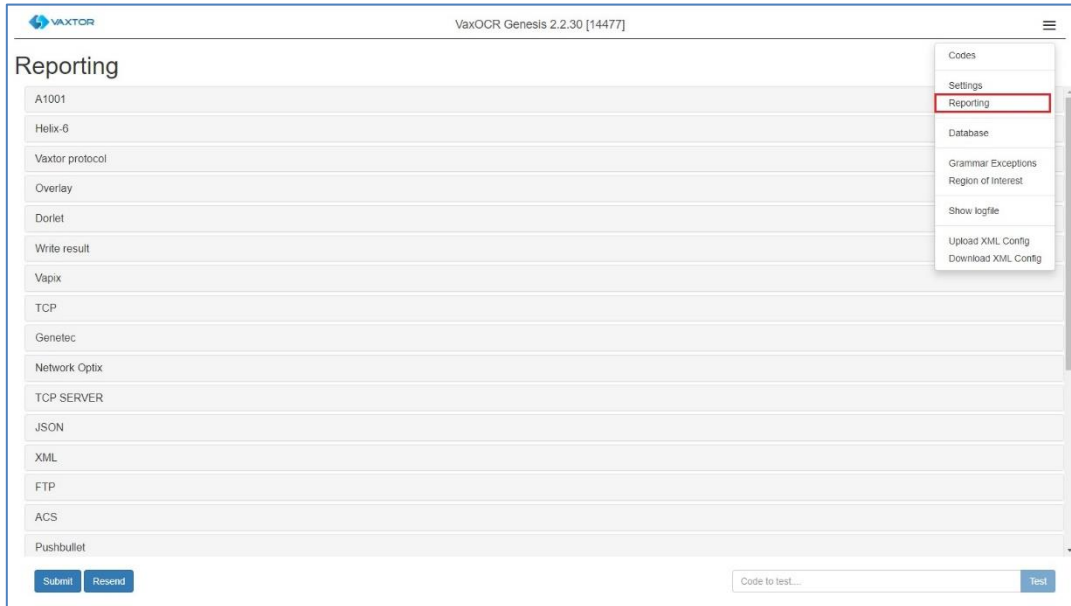
By selecting one of the listed protocols, a sub-menu will appear with fields for setting up parameters such as remote IP addresses etc.   In the case of sending reads to Helix, select **Vaxtor protocol** and enter the IP address of the receiving PC, the port number to be used and the Code ID to be sent:

Send duplicate images is used in cases where an object to be read is stationary for some time in the field of view.   Note that the user can set 'Same code delay' (seconds) to specify a time to wait before attempting to read the same code again (see earlier in this manual). However, here the user can instruct the reporting software to never send duplicate images of the same code by unticking the box - or it may be that the user wants to see how long the object is present in the field of view and so DOES want duplicate images of the object sent every "n" seconds.

Note that this list of protocols is always being updated, contact Vaxtor for details.

See the separate manual: "VaxALPR On Camera Integration" for more details of Vapix and how to communicate with Axis's own software.

Also see the separate VaxALPR On Camera Axis Software Developer's Guide for more detailed information on the reporting options.

Contact Vaxtor for details.

10.7 Show Logfile

You can view the application's log file by going to the main Axis App screen – selecting the VaxOCR Genesis App and clicking on **App Log**.
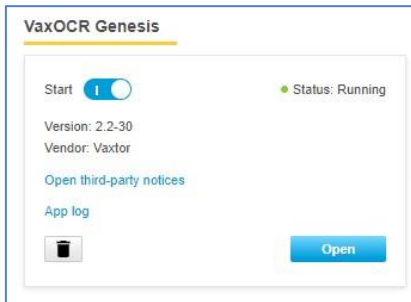
This will display a list of internal actions including any communication problems.

You can access this log from inside the App.

Select **Show Logfile** and a window will open showing the current logfile.
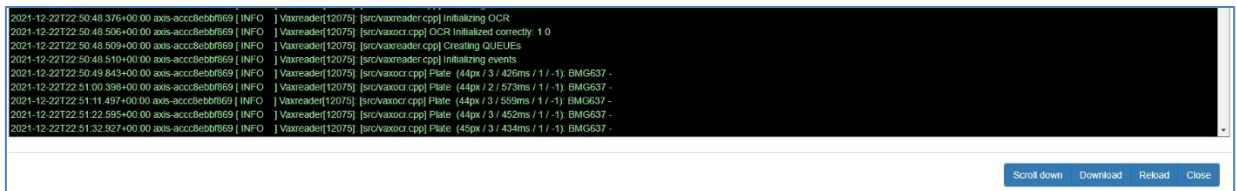
The software will write up to five logfiles of 10MB each before overwriting the earliest one. Logfiles are very useful in troubleshooting any problems and for examining the reads in detail.

Use the **Scroll bottom** button to look at the last items written.

Selecting **Reload** will refresh the display and show the latest entries to the log.

Download will save the current log in your Downloads folder on the PC that you are using to remotely access the camera.

Select **Close** when finished.

10.8   Download XML Config

Once all your App settings are complete you can use this feature to save all of these settings as a backup into your Downloads folder.

The data is saved as an .xml file and may be viewed as a standard text file or even edited.

10.9   Upload XML Config

Having saved one or more .xml backups – they may be reloaded by selecting this option.

Note that these two functions are very useful if you have a lot of cameras to configure. Remember that you still might have to make small changes to each one if the camera views are different (maybe different ROIs) – and maybe the Camera ID if the cameras are all transmitting to a centralized Back Office such as Helix.

11. Troubleshooting

Many code reading issues/errors are caused due to:

- Incorrect positioning of the camera
- Incorrect camera lens (or zoom setting)
- Insufficient illumination
- Incorrect camera settings - e.g. shutter speed
- Incorrect settings of the App.

In this section, we will study the most common of these issues and how to fix them.

11.1 The VaxOCR Genesis On Camera software starts and then stops suddenly.

Solution:

Check that you have uploaded the license key and check that the date and time of the Axis camera is set correctly.

11.2 The VaxOCR Genesis Camera license is valid but a 'Check license' message appears.

Solution:

Check that the date and time of the Axis camera is set correctly.

11.3 The VaxOCR Genesis software is running but not reading codes.

Solution:

Check if you can see the target code in the image and that the image is of good quality, not under or over exposed.   As a general rule, if you as a human being can't easily read the codes - then the software won't be able to read them either!
Image is everything so first try to adjust the camera lens to zoom in or out. Failing that, check if the camera itself can be repositioned closer or further from the reading point. The captured image should show the area around the desired codes. This however depends on the resolution that the camera has been set to.

If the video quality looks good then go to the camera's settings and ensure that the shutter speed is set high enough. (See earlier in this manual for a guide to shutter speeds)

If you CAN see the code clearly in the image and the software is not reading anything, try changing following parameters in the settings section of the App to be more tolerant:

1. In the Video options, change the **Minimum Character Height** to 14 pixels.

---

2. In the Video options, change the **Maximum Character Height** to 70 pixels.
3. In the OCR options, change complexity to High but be mindful of the increase in processor power required.
4. In the Region of Interest section, delete any existing **Region of Interests** (ROIs).

Once you can see the code image and the software is now reading, change these settings back one by one.

11.4 The VaxOCR Genesis software is running but it does not read all of the codes.

Solution:

In the VaxOCR Genesis configuration, in the Video options, check that the value of the resolution in the drop-down list is adequate.

In the App's main options on the right – select Show logfile.

Scroll to the end of the log file (Scroll bottom) and look for the message:

[INFO] Vaxreader[xxxx]: -Code 0 (<pixel height> - <milliseconds>): <code>
and check the value of the code's character pixel height registered in the log.
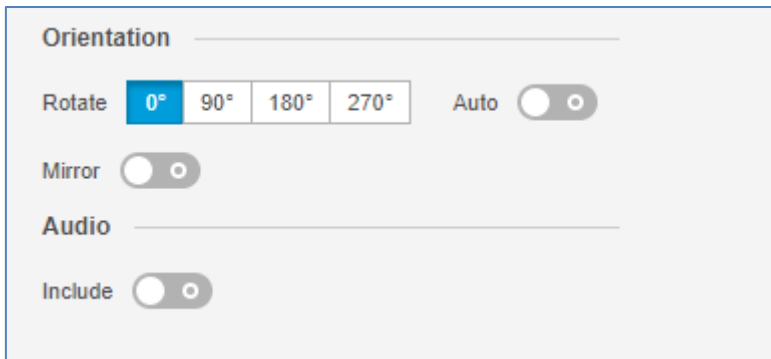
11.5 Images of a code appear inverted.

After installing a new Axis camera, sometimes the image may appear upside down after being read. Note that the camera has an auto-sensor to determine the orientation.

Solution:
Set the correct orientation required in the Axis Camera Settings/ Stream section:
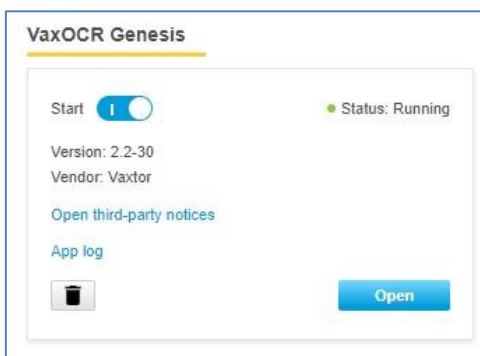
After changing this (or any other settings in the camera) you should stop start and restart the VaxOCR Genesis Application – and all should be well.
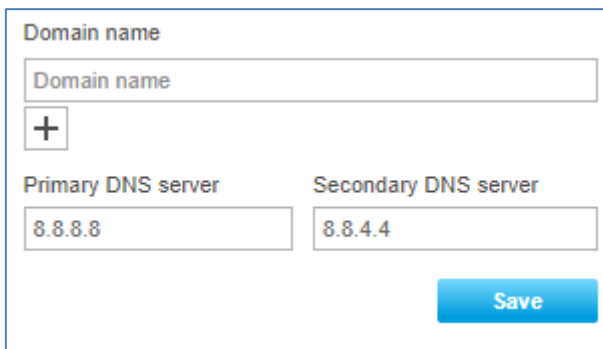
11.6   JSON or TCP setup but no codes being received

Solution

If you are using a remote URL to receive the data, check that a DNS server has been selected in the Axis camera Settings.
Go to the main Axis Setting menu and select System and TCP/IP. Select a DNS server such as:

8.8.8.8 with a secondary server of say 8.8.4.4.   These are free Google DNS servers which will map your URL names.

12. Words Available for Dynamic Text Replacement

- **$image$**: Full JPEG image encoded in base64.
- **$jpegsize$:** JPEG size in bytes.
- **$date$**: Timestamp in ISO8601 format
- **$code$**: Code number
- **tag**: Unique hash for this plate number. Same plate number will always give the same tag. Format based on UTMC algorithm.
- **$plateutf8$**: Plate number in utf8 format.
- **$country$**: Full country of origin name.
- **$countrycode$**: 3 letter country code.
- **$state$**: Plate State for USA.
- **$category$**: Plate category for countries that support it.
- **$blacklist$**: Description on the blacklist linked to the plate number.
- **$whitelist$**: Description on the whitelist linked to the plate number.
- **$ifblacklist$ .... $ifblacklist$**: If the plate is on the blacklist, the text in the 'if clause' will be displayed.
- **$ifwhitelist$ .... $ifwhitelist$**: If the plate is on the whitelist, the text in the 'if clause' will be displayed.
- **$ifnolist$…$ifnolist$:** If the plate in not on a list, the test in the 'if clause' will be displayed.
- **$confidence$**: Global confidence (0-100).
- **$charheight$**: Average charheight (pixels).
- **$processingtime$**: Processing time in milliseconds.
- **$left$**: Left coordinate for the plate on the image (pixels).
- **top**: Top coordinate for the plate on the image (pixels).
- **$right$**: Right coordinate for the plate on the image (pixels).
- **$bottom$**: Bottom coordinate for the plate on the image (pixels).
- **$absoluteleft$**: Plate left position based on the total image width (0-1).
- **$absolutetop$**: Plate top position based on the total image height (0-1).
- **$absoluteright$**: Plate right position based on the total image width (0-1).
- **$absolutebottom$**: Plate bottom position based on the total image height (0-1).
- **$width$**: OCR image width.
- **$height$**: OCR image height.
- **ip**: Camera IP address.
- **$roiid$**: Roi ID where the plate number is found.
- **$speed$**: Vehicle speed (Km/h).
- **$multiplate$**: Amount of times that the plate has been read before reporting.
- **$signaled$**: True if the read has been done due to a trigger.
- **id**: Database ID for this read.
- **$direction$**: Enumerate with the vehicle direction (0: Unknown, 1: Towards, 2: Away, 3: Stopped)
- **$directionstr$**: String with the vehicle direction.
- **$safedate$**: Date in format %Y%m%d_%H%M%S in the camera time zone (Useful for filenames).
- **$localdate$**: Date in format %d/%m/%Y in the camera time zone
- **$localtime$**: Date in format %H:%M:%S in the camera time zone.
- **$imageid$**: Signal ID in case of a trigger read.
- **$plateimage$**: Plate crop JPEG image encoded in base64.
- **$platejpegsize$**: JPEG size in bytes.
- **$overviewimage$**: Overview JPEG image encoded in base64.
- **$overviewjpegsize$**: JPEG size in bytes.
- **$epoch$**: Unix epoch (seconds).

- **$utcdate$**: Will report the date at ISO8601 format but always in UTC. (2020-12-31T16:11:30.000Z)
- **etx**: End transmission character (03)
- **stx**: Start transmission character (02)

12.1 Note on UTC time format:

Time UTC: 2021-04-13T00:50:15.000Z
(YYYY-MM-DDTHH:MM:SS.mmmZ - The last Z indicates the time is UTC)

Local Time: 2021-04-13T00:50:15.000-03:00
(YYYY-MM-DDTHH:MM:SS.mmm±hh:mm - Where the last ±hhmm is the difference from UTC time)

13. Genesis Grammar Rules Definition

13.1 Grammar rules information structure

Vaxtor OCR Genesis requires a simple ASCII file which includes a set of syntactic and grammar rules to be applied, separated by a new line sequence.

The grammar file structure is made up 3 different sections:

- **Character replacement and deletion rules**
- **Definition of variables**
- **Grammar rules**

To define the components in each section we use three different types of items:

- **Tokens: representing literals of a specific type**
- **Basic operators and definitions**
- **Characters and digits representing their own explicit value**

13.2 Tokens, operators, and definitions

(See Appendix for ASCII codes for the special characters mentioned below)

13.2.1 Replacement and deletion rules section

^   The rule for a replacement applies to the first characters of the sequence

$ The rule for a replacement applies to the last characters of the sequence

?   Mark character for deletion

~   Replacement rule separator

13.2.2 Definition of variables section

=   Variable assignment

13.2.3 Definition of variables and grammar rules sections

[,]   OR clause between the statements inside the brackets.

13.2.4 Grammar rules section

%{} Variable usage

%0 Void, no character

N: Rule matches if the character sequence is arranged in N lines where 1<=N<=3

13.2.5 Common to all sections

%D Numeric character: "0123456789"

%L Alphabetic character: "ABCDEFGHIJKLMNOPQRSTUVWXYZ"

%V Vowels "AEIOU"

%C Consonants: "BCDFGHJKLMNPQRSTVWXYZ"

*   Alphanumeric character (numeric or alphabetic)

\#   Start comment

13.3   Replacement rules section

Rules to erase or replace a specific alphanumeric with another one

- The OCR can't differentiate O/0, it will always output 0 (zero)
- The OCR can't differentiate I/1 when the representation is just a vertical line "I"

This section is particularly useful to "force" the replacements because the same alphanumeric shape can have different meaning depending on the context or use case.

Format:

[^]<input pattern>[$]~ [^][^]<output pattern>[$]

- The token around the pattern indicates the matching position in the sequence, in case of having no token the rule applies to the first match anywhere in the sequence.
- A pattern made up of literals and at least one explicit alphanumeric to be replaced or erased
- The tokens and the literals for the input pattern and the output pattern must be the same, only the explicit alphanumeric to replace or erase must change.
- The replacements and deletions apply sequentially when having more than one replacement or deletion statement.

Example 1:

Grammar rule of our text: 3 letters and 3 digits

Sample texts: ABC123, VHR394, PPW992...

Rule: If the first character is a 0, replace with O

^0%L~^O%L   => Correct

^0%L%L%D%D%D~^O%L%L%D%D%D   => Correct, more robust approach

0%L~O%L   => Incorrect, it could replace the second character

Example 2:

Grammar rule of our text: one or more digits and 1 character (any)

Sample texts: 4364R, 449232S, 253O...

Rule: Replace the last 1 with I and 0 with O. We need 2 replacement rules:

%D1$~%DI$ => If the last character is 1, replace with I

%D0$~%DO$ => If the last character is 0, replace with O

Example 3:

Grammar rule of our text: one or more alphabetic characters

Sample texts: AR, PGKDS, GHJSO, SPII34...

Rule: Replace every 1 with I and every 0 with O. We need 2 replacement rules

1~I   => Replace every '1' with 'I'

0~O   => Replace every '0' with 'O'

Example 4:

Grammar rule of our text: 2 characters and 3 numbers

Sample texts: AO923, KJ145, OI992...

Rule: Replace any '1' with 'I' and '0' with 'O' in the first 2 positions

Valid but weak approach	Valid and robust approach
^1*~^I*	^1*%D%D%D~^I*%D%D%D
^0*~^O*	^0*%D%D%D ~^O*%D%D%D
^*1~^*I	^*1%D%D%D ~^*I%D%D%D
^*0~^*O	^*0%D%D%D ~^*O%D%D%D

Example 5:

Grammar rule of our text: 5 alphanumerics sequence

Sample texts: AB834, 98HUO, 1299W...

Rule: Replace any 5 alphanumeric sequence with the number 99999

^*****$~^99999$

Example 6:

Grammar rule of our text: 5 digits

Sample texts: 23425, 44536, 75433...

Rule: Remove every alphabetic character from the sequence

%L~?

%D%D%D%D%D

Text: 23456P   Result: 23456 (it matches the grammar)

Text: A82BC89U3Result: 82893 (it matches the grammar)

Text: B8923CB   Result: 8923 (it does NOT match the grammar)

13.4 Grammar rules section

Set of grammar rules to follow by the characters sequence. The rules will be processed sequentially after executing the replacement section (if any).

Basic examples, fix length sequences

6 digits	%D%D%D%D%D%D
3 digits and 3 consonants	%D%D%D%C%C%C
Starts with 'P' followed by 5 digits	P%D%D%D%D%D
3 digits and 2 consonants	%D%D%D%C%C

Combining fixed length sequences with replacements

3 digits and 2 characters

1*$~I*$	# Replace last but one '1' with 'I'
0*$~O*$	# Replace last but one '0' with 'O'
*1$~*I$	# Replace last '1' with 'I'
*0$~*O$	# Replace last '0' with 'O'
%D%D%D%L%L	# Apply grammar rule, 3 digits and 2 characters

2 vowels and 4 digits assuming our 'I' letter is represented by 'I' or 6 digits sequence

^0*%D%D%D%D~^O*%D%D%D%D	# Replace the first '0' with 'O'
^*0%D%D%D%D~^*O%D%D%D%D	# Replace the second '0' with 'O'
%V%V%D%D%D%D	# Apply rule 1
%D%D%D%D%D%D	# Apply rule 2

Variable length sequences: introducing the 'OR' clause and the void literal

5-6 digits	%D%D%D%D%D[%D,%0]
5 digits ending in A, B, or C	%D%D%D%D%D[A,B,C]
2-4 digits and 1 or 2 consonants	%D%D[%D,%0] [%D,%0]%C[%C,%0]
Starting with 'AZ12' and 0-2 alphanumeric	AZ12[*,%0] [*,%0]

9 digits phone numbers starting with 609 with and without any 1-3 digits prefix

[%D,%0] [%D,%0] [%D,%0]609%D%D%D%D%D%D

3 or 4 digits numbers alone or preceded by 'AA' or 'BB'

[AA,BB,%0]%D%D%D[%D,%0]

Introducing the variables definition

The definition of variables appears in the second section, between the replacements and the grammar rules definition section. You should include those definitions before specifying any rule. The format is as follows:

<variable_name>=<grammar_rule>

The name of the variable includes alphanumeric and non-token characters, it may not include blanks.

3 digits and 2 consonants

MY_VARIABLE=%D%D%D   # Variable definition

%{MY_VARIABLE}%C%C   # Using the variable in a grammar rule

Combination of 2 characters AA,BB,CC,DD followed by 4 to 6 digits

COMBO=[AA,BB,CC,DD]

%{COMBO}%D%D%D%D[%D,%0] [%D,%0]

Note that any combination of characters *not* defined by COMBO won't match the rule

2 numbers plus AA,BB combination plus 2-4 numbers plus C,D,E,F,G characters

VAR1=[AA,BB]

VAR2=[C,D,E,F,G]

%D%D%{VAR1}%D%D[%D,%0] [%D,%0]%{VAR2}

Read the following words only: STOP, YIELD, SPEED, and 'speed' is followed by 2 or 3 digits

 # Section replacement

^ST0P~^STOP   # Replace the 0 with O

^Y1ELD~^YIELD   # Replace the 1 with I

 # Section variables definition

WORDS=[STOP,YIELD]

 # Section grammar rules

%{WORDS}   # Rule 1: stop or yield

SPEED%D%D[%D,%0]   # Rule 2: speed plus a 2 or 3 digit number

Read numbers of 5-6 digits where every digit is equal or greater than 6

N=[6,7,8,9]   # Numbers allowed

%{N}%{N}%{N}%{N}%{N}[%{N},%0]   # 5 or 6 digits number of allowed numbers only

Combination of 2 colors separated by an odd number

0~O

1~I

%L%L%LI%L%L%L~%L%L%L1%L%L%L

N=[1,3,5,7,9]

COLOR1=[RED,BLUE,YELLOW,ORANGE,BLACK,WHITE]

COLOR2=[GRAY,GREEN,PINK,BROWN,MAGENTA,VIOLET]

[%{COLOR1},%{COLOR2}]%{N}[%{COLOR1},%{COLOR2}]

Selective rules depending on the number of lines the sequence is arranged

The OCR can process 1, 2, or 3 line codes, the rules apply to any of them by default. However, it is possible to constrain the rules to the number of lines of the code.

<number_of_lines>:<grammar rule>   *# Number of lines can be 1, 2 or 3*

Rule: **%L%L%L%D%D%D%D**   # Default, it applies to any arrangement

Rule: **1:%L%L%L%D%D%D%D**   # It applies to 1 line sequences only

Rule: **2:%L%L%L%D%D%D%D**   # It applies to 2 lines sequences only

Rule: **3:%L%L%L%D%D%D%D**   # It applies to 3 lines sequences only

13.5 Example, extracting information from fast-food ticket restaurant

Real ticket

Grammar rules

DATE=%D%D%D%D%D%D%D%D

TIME=%D%D%D%D%D%D

CAJA%D[%D,%0]%{DATE}%{TIME}

OCR results

13.6   Example, extracting digits from a long code/date

Let's imagine that we have this code:

But we're interested in reading only the code inside the red rectangle:

The OCR internally is going to read all of the alphanumerics: **KJ21240140520**

The valid grammar for this in Genesis would be %D%D%D%D%D%D%D

However, this is not enough, we need a mechanism to tell Genesis the proper way to isolate the code we're after.

The grammar rule **%D%D%D%D%D%D** matches the code we want, but if we define this as a grammar rule then Genesis will behave as follows:
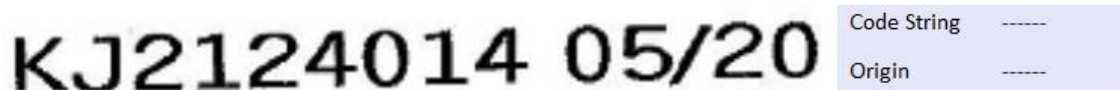
Grammar Strict OFF

Grammar Strict ON

As you can see there is no way to isolate the code by conventional mechanisms.

SOLUTION:

Make use of the '?' token to erase characters in the replacement sections, as explained earlier in this manual.

There are several ways to setup the proper rules:

1. Isolate the KJ code at the beginning: **%L~?** This rule will replace all non-numeric characters from the string. We can be more accurate and narrow the replacement to the first 2 characters **^KJ~^??**

2. The second rule causes the removal of the last 4 digits; there are several ways to achieve this too: **%D%D%D%D$~????$**
   This rule will remove the last 4 numbers of the code.

So, the full grammar to isolate and read our 7 digits code will be:

%L~?

%D%D%D%D$~????$

%D%D%D%D%D%D%D

Now, if we wished to isolate these parts of the code:

The Grammar rules would be:

^KJ%D%D%D%D%D%D%D~^KJ???????

KJ%D%D%D%D

Result:

14. ASCII SPECIAL CODES

To enter the following special codes, use the ALT key followed by digits on the numeric keypad:

^   ALT + 94

~   ALT + 126

[ALT + 91

]   ALT + 93

{   ALT + 123

}   ALT + 125

15. Changelog

15.1 Version 23-12/2021

- ✓ Strict Grammar update.

Ends.