White Paper
Installation and Design Requirements for Successful Analytic Deployment with ARKIV

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Video analytics are a set of tools to automatically interpret the video content for specific application outcomes. The accuracy of the analytics is dependant on the care taken in the design and deployment of the entire system.

There are many methods of deploying analytics within a camera system whether it be within the camera, in a dedicated appliance or within the server. This document describes the design criteria for ARKIV's server-based analytics. As such, care must be taken to ensure that the physical server hardware is capable of providing the processing power required for the specific analytics and quantity of analytics your application requires.

Core Detections and Content Analysis

Core detection and Content Analysis are the generalized motion and object classification analytics within the detection tools. These analytics are used to provide forensic search based on ad hoc criteria and live macro triggering based on establish criteria.

Typical Scene Analytics are line crossing, motion in an area, unattended objects, etc. These analytics can then be further refined based on object classification based on size, shape, speed, and colour. Further filtering and accuracy can be achieved with neural network filters.

General Requirements

1. Camera requirements:
    a. Frame resolution:
        i. Min. 640x480 pixels for Scene Analytics
        ii. Min. 300x300 pixels for Neural Tracker Scene Analytics;
        iii. Min. 320x240 pixels for core detection tools.
    b. Frames per second:
        i. Min. 6 fps for Scene Analytics;
        ii. Min. 1 fps for core detection tools.
    c. The image should not contain noise and not have any compression artifacts.
2. Camera shaking must not cause image shifting of more than 1% of the frame size.
3. Lighting requirements:
    a. Moderate lighting: Lighting that is too little (night) or too much (bright sunlight) may impact the quality of video analytics.
    b. Consistent: No major fluctuations in lighting levels.
4. Scene and camera angle requirements:
    a. Moving objects must be visually separable from each other in the video.
    b. The background must be primarily static and not undergo sudden changes.
    c. Minimal obstruction of moving objects by static objects (columns, trees, etc.).
    d. Reflective surfaces and harsh shadows from moving objects can affect the quality of analytics.
    e. Long single-color objects may not be tracked properly.
5. Object requirements:
    a. The width and height of the objects in the image must be at least 1% of the frame size (if resolution is over 1920 pixels) or 15 pixels for lower resolution.
    b. The width and height of the objects in the image must not exceed 75% of the frame size.

c. The speed of objects in the frame must be at least 1 pixel per second.
d. In order to detect the object, it must be visible for at least 8 frames.
e. Within two adjacent frames the object cannot move further than its size in that direction of travel. This condition is essential for correct calculation of the object's trajectory (track). Frame rates must be increased for faster object tracking.
f. Must have less than 25 individual objects to track within the cameras field of view

Installation:

1. Secure and stable mounting locations must be selected. Consider the potential flex in the structure on which the camera is being mounted.
2. If lighting consistency is a concern, consider using thermal cameras to reduce the impact of light on the analytic.
3. Camera field of view must be wide enough to ensure sufficient movement and frames size relative to the objects of interest.

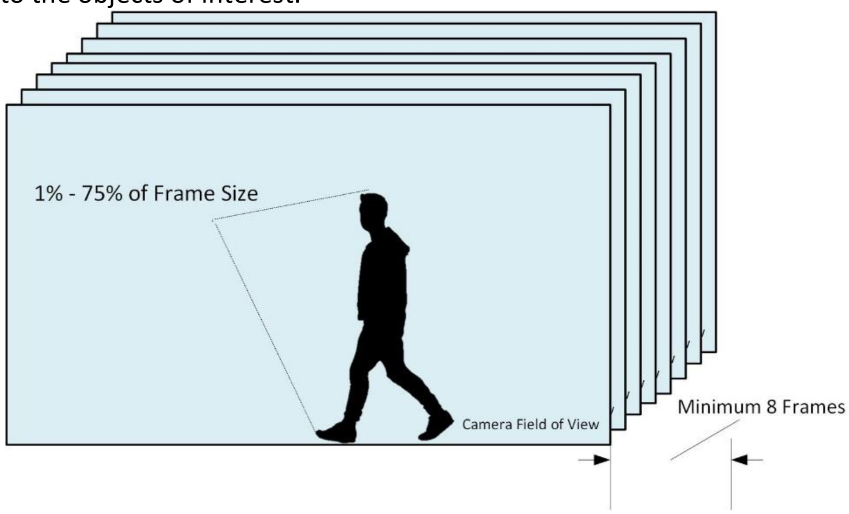

Figure 1: Graphical Representation of General Requirements for Core Detection and Scene Analytics

Design Process:

1. Determine objects of interest and their expected size and speed within the field of view.
2. Consider the region of observation to ensure the field of view will be sufficient to observe the object for the minimum number of frames.
3. Identify camera requirements based on required frame rate (object speed) and pixel density (object size).

FPS	Max Detectable Speed	
	Human	Vehicle
6	5 km/hr	40 km/hr
12	10 km/hr	85 km/hr
25	20 km/hr	170 km/hr

LPR – License Plate Recognition

License Plate Recognition (LPR) identifies a license plate within the selected detection window and runs an optical character recognition (OCR) algorithm to create a database of searchable license plates. When the OCR algorithm is unsure of the license plate, that record entry in the database will provide all permutations of the license plate. For example, a letter B could be represented as being also an 8 or a 3 in the resulting character string if the image is not clear – so the database would have three versions of the same license plate.

The application of the LPR analytic is for situations where the operator has a license plate of interest and needs to quickly find all the video events where that license plate as crossed in front of the LPR camera.

General Requirements:

1. License plate should be 90 – 120 pixels / foot.
2. The height of the characters should be at least 15 pixels and the stroke width at least 2px
3. Minimum allowable contrast for a uniform background on the license plate is 10% (25 on a 256-point scale)
4. Maximum non-uniform background fluctuation should be no more than 12% (the ratio of brightest to darkest parts of the license plate background)
5. Requires at least 3 frames with the license plate in it
6. Maximum vehicle speed is 120 km/hr

Installation:

Camera installation location should be chosen for the following criteria

Camera tilt (from center of lens to center of license plate vertically): < 30°
Camera pan (from center of lens to the center of the license plate horizontally): < 20°
Skew to the bottom of the frame: < 5°

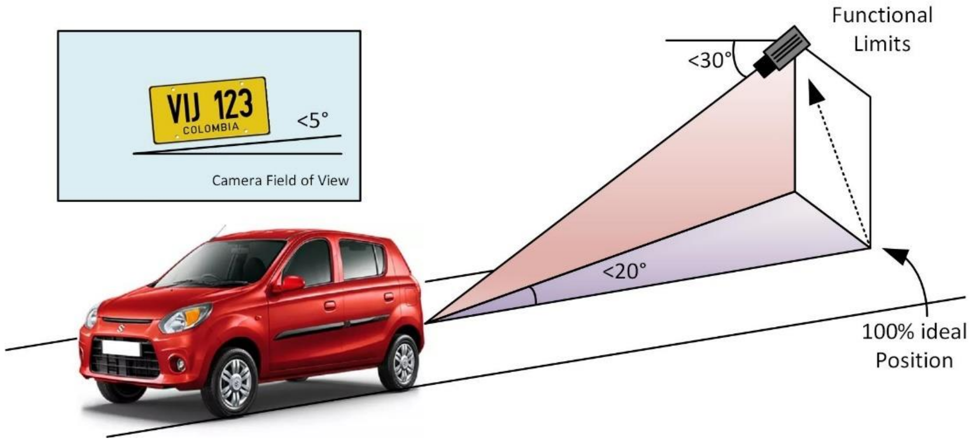

Figure 2: Graphical Representation of tilt, pan, and skew limits

Design Process:

1. Identify the target area for the license plate
2. Consider light sources, glare, object speed, etc. Ideal locations are at entrances and exits where vehicles must slow or stop.

3. Use right triangle equations to identify the ideal / possible camera installation locations, keeping the angles as close to zero as possible on the tilt and pan.

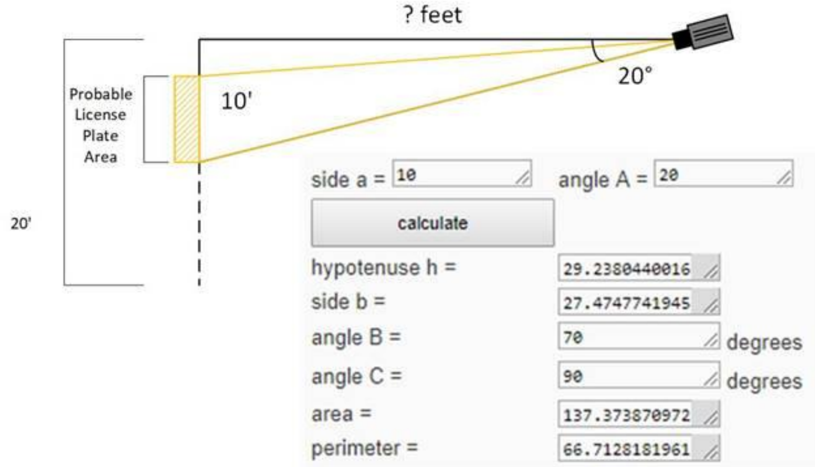

Figure 3: Example Camera Pan Calculation

4. Use a pixel density calculator, such as the Vidi Labs [i]app to identify the required resolution.

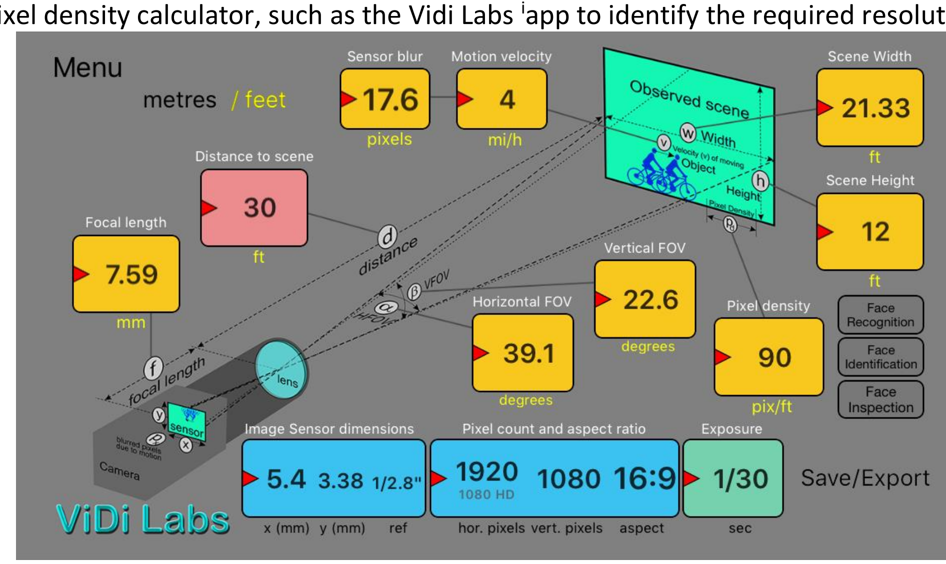

Figure 4: Example VidiLabs Calculator – Identifying that we need an 8mm lens on a 1080P Camera to achieve 90 px/ft.

5. Identify the correct camera model to achieve the calculated pixel density.

Camera selection:

- Black and white images provide better results in a variety of light conditions; however, color is acceptable.
- High or Ultra Wide Dynamic
- High frame rates – such as 60 fps will improve functionality
- Form factor for the lowest possible mounting locations

Facial Recognition

Facial Recognition identifies the face within the video frame and creates a numerical representation of the facial structure / geometry. The resulting number is stored in a text database allowing an operator to run a search by inserting another image of a face from the same source or a different source and creating a comparison to find all instances of that face presented to that camera.

General Requirements:

1. Distance between pupils the must be at least 50 pixels
2. Minimize the chances of overlapping faces in the field of view
3. Evenly illuminate the faces in field of view. Avoid directed light from the side
4. Face shots from cameras should be clear. No image blur caused by human motion.
5. Range of contrast on the face must be at least 64 shades of gray.

Installation:

Camera installation location should be chosen for the following criteria

Camera tilt (from horizontal): < +/-15°

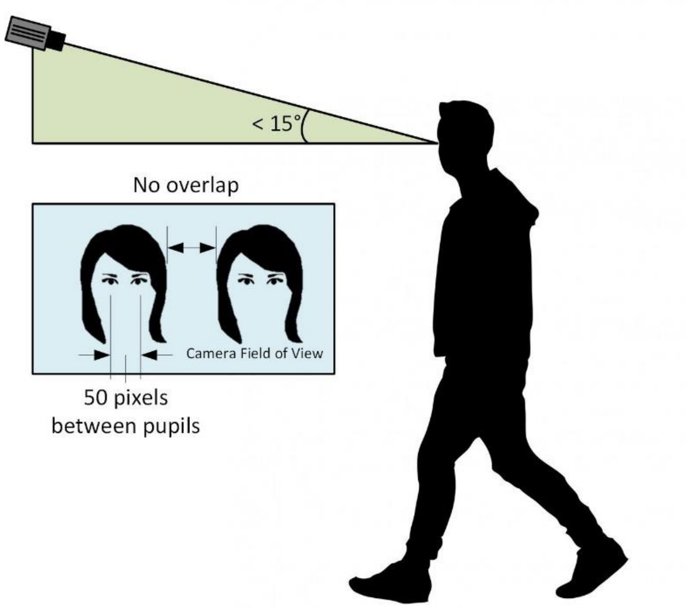

Figure 5: Graphical Representation of Facial Recognition

Design Process:

1. Identify the target area for the face – ideal locations are at choke points such as doorways, turnstiles, and hallways.
2. Consider light sources, glare, speed of the object, etc. Ideal locations are where obstructions require careful, slow walking.
3. Use right triangle equations to identify the ideal / possible camera installation locations, keeping the angles as close to zero as possible on the tilt considering a variety of human heights.
4. Use a pixel density calculator, such as the Vidi Labs app to identify the required resolution.

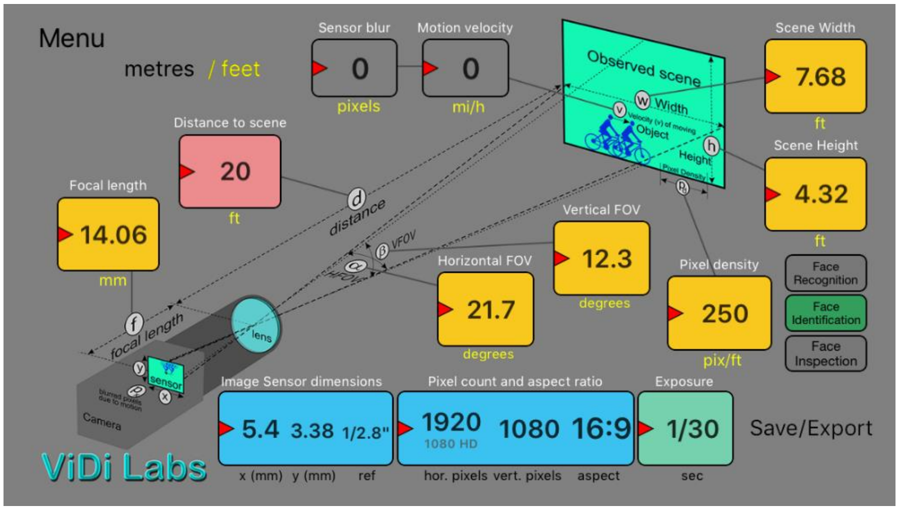

Figure 6: Example Calculation of Pixel Density using the Vidi Labs application.

5. Identify the correct camera model to achieve the calculated pixel density.

   Camera selection:
   - Resolution
   - Focal Length
   - Dynamic Range
   - Available Frame Rates
   - Form factor for the lowest possible mounting locations

For the implementation of these analytics within the ARKIV software, please review the ARKIV user guide.

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[i] Vidi Labs is not associated with Inaxsys or the ARKIV software package. Information on Vidi Labs is available at https://vidilabs.com/ and is simply referenced in this document as an example of a tool to determine the required pixel density for an application.