How To Minimise ROULETTE WHEEL MOTION BLUR

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Once I was approached by a casino professional, asking me if I could help him find a camera with 60fps, which he wanted to use with the casino's roulette tables. I asked him about the purpose for such a camera before I gave him my response. Certainly, I knew of a handful of Internet Protocol (IP) camera manufacturers that had 60fps cameras (some even more than 60fps) in their range, but I sensed that the question was based on a lack of understanding of how cameras work (more specifically, the electronic shutter) rather than a real quest for a camera of high frame rate. Additionally, high frame rate cameras are usually more expensive.

When the customer explained that the images from his roulette wheel winning numbers appeared very blurry and customers were complaining about it, I knew what the problem was. Let me explain.

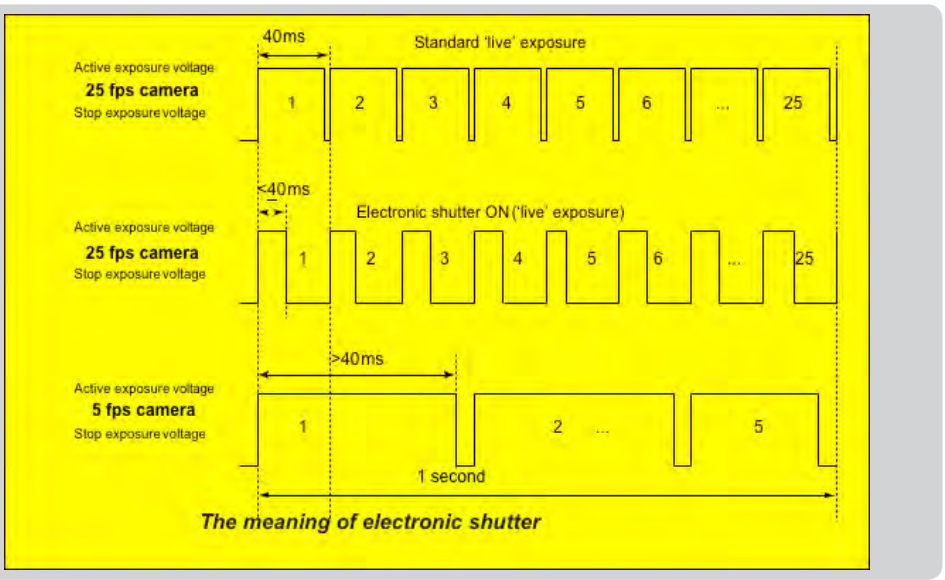
Cameras are often used to look at roulette wheels and display the winning number as soon as the roulette ball lands on a number. Casino dealers do not wait for the roulette wheel to finish spinning, as this takes quite some time and players will not wait. The most practical thing for them is to wait until the ball, after jumping around, lands in the winning number area and, while the wheel is still spinning, they show a snap-shot image of the winning number on a large screen.

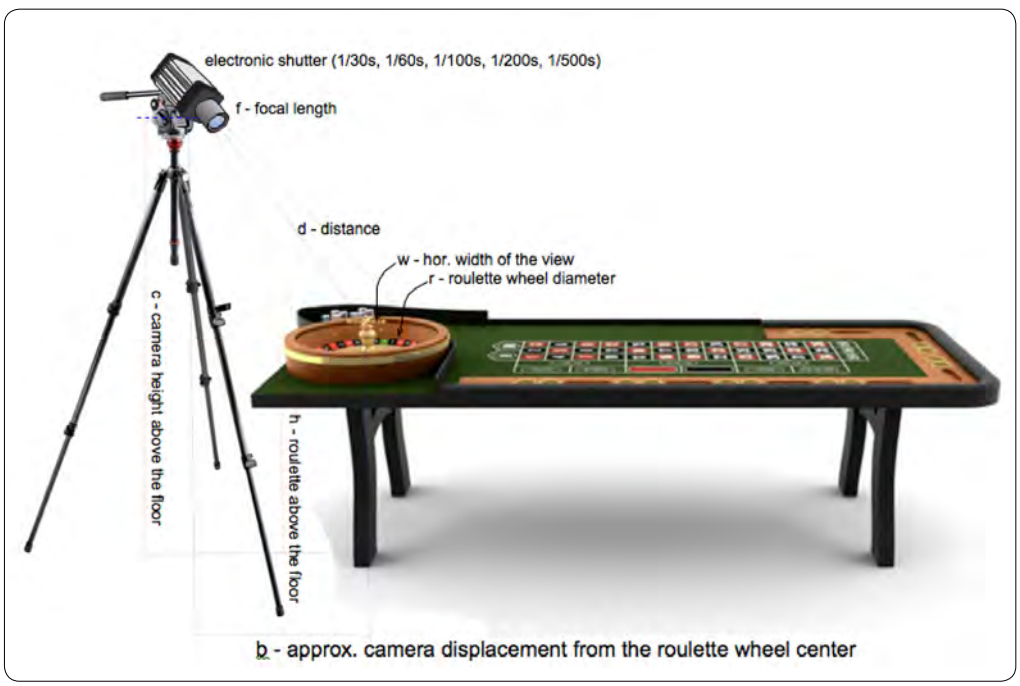
The light conditions are usually very low, typically no more than 10lux at the gaming tables, which forces the cameras to expose each frame at least 1/25s (or 1/30s) in order to produce 'live' video. It may well be that the exposure could be even longer if the cameras are left in integration mode.

The results are blurry videos of the roulette wheels, with hard-to-read winning numbers. No

Longer shutter – hard to see numbers

Shorter shutter – sharper winning numbers

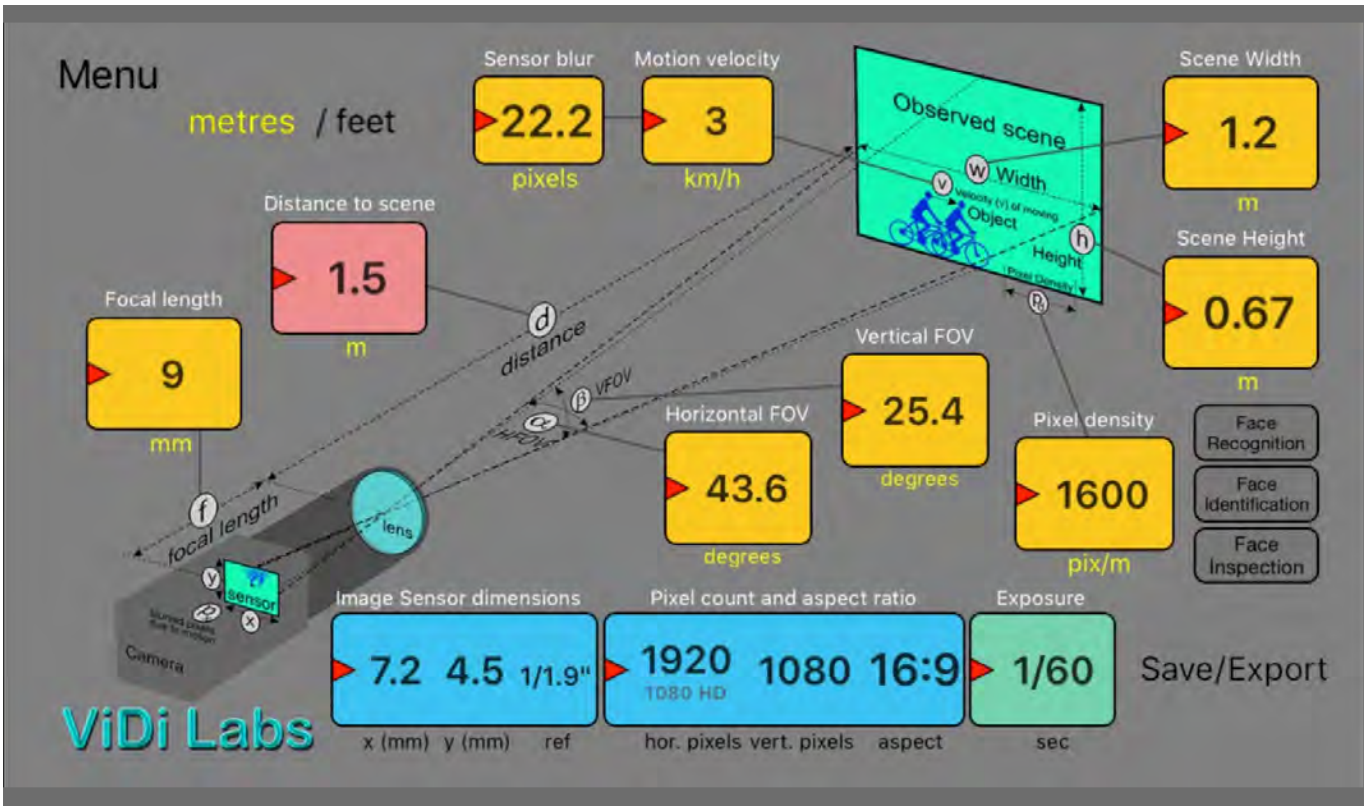




An Example

In this example, the following variables are used:

- IP camera with 1/1.9" sensor
- HD resolution = 1920 x 1080
- lens = 9mm
- distance from camera to the roulette wheel approximately 1.5m



wonder roulette players are not happy and are asking for better and faster information from the roulette tables.

The customer that asked me this question did not necessarily need a high frame rate camera. All he needed was to set the camera to a higher electronic shutter (exposure), so that the motion blur from the roulette wheel was minimised to the level that clearly shows the ball and the winning numbers.

So, what exposure does he need to set the camera to? This can easily be calculated by the ViDi Labs calculator application. Using the Sensor blur calculation, which is produced by a moving object with a known speed, a casino operator can calculate the most acceptable electronic shutter speed in order for the camera to see sharp winning numbers.

A little bit of imagination and length measurement is required, but the hard work is done by the calculator.

The shorter the exposure (with the same lens and F-stop), the more light required for a good picture. It is, however, important to consider that every IP camera has built-in Automatic Gain Control (AGC), which even when the light levels are lower will push the video signal to be close to the nominal values of full video (1 App in the analogue days and around 800mVpp in the digital world).

Using the calculator, we can find the longest exposure for the acceptable motion blur.

The blur will always be there, even at the shorter exposure, since the roulette wheel is still spinning, but it will be much sharper than having the default 'live' exposure of 1/25s (or 1/30s).

Our tests and experiments have shown that using high frame rate cameras (for example, 1/60s instead of 1/30s) will hardly reduce the motion blur. As it can be seen on the above screenshot, there were around 21 pixels of blurriness produced on top of the actual roulette ball, and 29 pixels of blurriness on top of the roulette wheel numbers (a total of 50 pixels in the horizontal direction). This effect makes the numbers still appear blurry. The ViDi Labs calculator gave a result of 22 pixels of blurriness.

By setting the camera's electronic exposure to 1/250s, the resultant frozen image appears much sharper and the roulette numbers can be clearly read. The ViDi Labs calculator indicated that there will be 5.3 pixels of blurriness when motion velocity is 3km/hr. This is sufficient to see the numbers on the roulette wheel more clearly. So, although a higher frame rate camera (60fps or 120fps) was not installed, a sharper video of 25fps was produced just by setting the electronic exposure to 1/250s. Problem solved!

To Summarise

Motion blur depends on five parameters: the sensor size, lens focal length, camera to object distance, pixel count and the electronic exposure setting. All of these parameters are considered by the ViDi Labs calculator, which is why the results produced in the experiments agree with the theory.

The motion blur calculation is unique in our industry and is a product of continuous research. It can also be used in licence plate recognition cameras, or in places where people are running or riding bicycles. It can be used almost anywhere where there is motion and can always give users a suggestion of the longest exposure they need to set their cameras to in order to see sharper images.

ViDi Labs calculator is available for iOS and Android. ■

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