Freezing fast moving objects

Overview

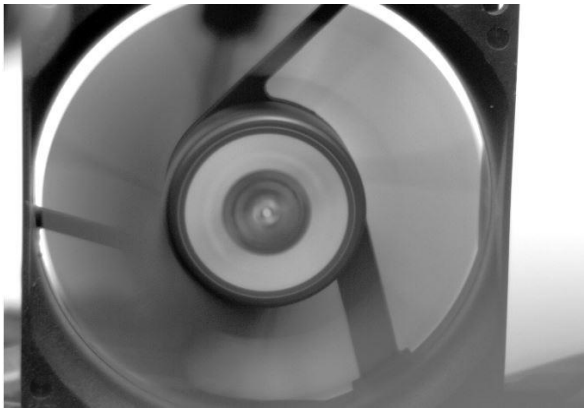
Blurring is the most common problem in machine vision solutions. In this article, we will demonstrate how to eliminate the blurring in our frame, which is depend on camera's parameters, frame's sharpness, and equipment help us to get clear picture.

Introduction

There are many difficulties which vision system's developers have to solve to get an image ready for processing. Integrating the vision system in an existing environment is challenging task. Uncontrollable real world's parameters can influence the project at all levels. Image blurring is one of the critical issues in machine vision solutions. Developers have to buy expensive light systems and very advanced cameras to avoid blurring effects. The analysis of factors which lead to the blurring effect and practical solutions are described in this article. Let's figure out where blurring coming from and how to avoid it effectively without significant spending.

1. What is image blurring and where does it come from?

Image blurring effect appears when one is shooting fast-moving objects, a reasonable question to ask is: how fast is fast? The answer to this question depends on a parameter of the camera called shutter. This parameter determines periods of time during which the camera is receiving light per one frame. If the object moves during shutter period all movements will be shot as blur object. Picture 1 shows a fan where all blades are blurry.



Picture 1 – Fan. Rotation speed 40 rps. Camera shutter 12ms. Diaphragm is fully opened. Zero gain. Regular fluorescent light.

Let's look at this example in picture 1. The fan is moving at 40 rotations per second (RPS). To get a clear image of the blades moving at this speed, the camera shutter should

be about 138 µs. The shutter parameter of 138 µs allows us getting a clear picture of the fan. The blurring of blades with this shutter will be less than 1◦ in the direction of rotation.

Picture 2 – Fan blade. Rotation speed 40 rps. Camera shutter 130 µs. Diaphragm is fully opened. Zero gain. EZSyncLed light.

Picture 2 shows the fan's blade with camera shutter 130 µs and special light by an EZSyncLed device which will be discussed in the following paragraphs.

2. What should be in a vision solution to get clear picture

Just enough to reduce shutter to get a clear picture? Developers who work with vision systems know that by tuning shutter low you have to provide very intense light.

Picture 3 – Fan. Rotation speed 40 rps. Camera shutter 1ms. Diaphragm is fully opened. Zero gain. Regular fluorescent light.

Let's return to our example with the fan. The shutter has to be in the range of 10–15ms to get a bright picture of the fan in an office room with regular fluorescent light and Point Grey Camera Firefly MV 0.3 MP Mono (Diaphragm is fully opened). However, the shutter's light intensity should be hundred times more to provide the same brightness of

picture with 138 µs! On the other hand, it is ineffective to provide continuous light with this intensity. It makes the vision system very inefficient in terms of power consumption, and it requires a stable current source.

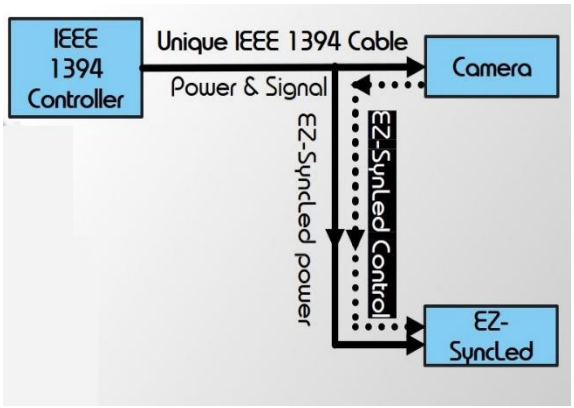
The strobing light is used to solve power consumption issue. A very intense light appears only in short period of time with synchronization with the external or internal signal.

In the case of sufficient intensity of light, we can set low shutter parameter like in the example and get a sharp image. The following sections describe setups of efficient strobing light sources.

3. What equipment help us to get these parameters.

There are a lot of companies on the market which supply light and optics for machine vision systems. Most of them require a special strobe controller to provide high power strobe signal on their lighting elements. It leads to an additional power supply for the controller and a time-consuming procedure of programming, thus, it increases the complexity of installation.

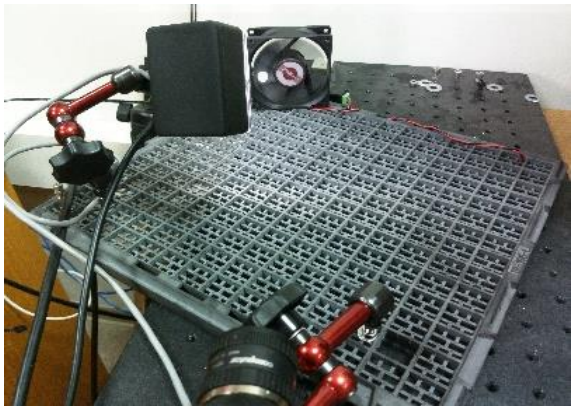
For an application like in our example, we need something easier to handle. Our requirements include strobe light length is about 130 µs, power (for LEDs) should be about 80 Watt, easy to install, easy to supply



Picture 4 – Schematic of connection FireWire camera with EZSyncLed.

For our purpose, the ideal choice is EZSyncLed from File X Ltd. company. It can provide a very short period of strobe light up to 1 µs and has 140W LEDs. The most interesting are that this device is powered by FireWire or POE cable and has low power consumption, which is around 3 Watts.

Another advantage is that sync-signal comes directly from the camera thus it requires to tune mode only in the camera and get the sync-signal according to each frame. Picture 4 and picture 5 show the connection scheme and simple setup, respectively.



Picture 5 – Simple vision system. Fan 40 rps observation.

Picture 6 – Fan. Rotation speed 40 rps. Camera shutter 83 µs. Diaphragm is fully opened. Zero gain. Strobe light impulse 90 us. EZSyncLed light.

That simple setup with strobing light by EZ-SyncLed allows us to provide a sharp image of fast moving processes like a fan rotation (Picture 6). Another big advantage of this technology is that we can fully eliminate other light sources from the environment, thus, it reduces reflections and other undesirable effects.

Conclusion

In this article, we have described where the image blurring effect comes from, which parameters have an influence on it, how to tune the equipment to eliminate blurring. We have also described how to make the life of Vision systems developers much easier by using equipment that provides consistent strobe light and does not require additional controllers or power supply cables.

*Fan was shot by Point Grey Camera Firefly MV 0.3 MP Mono FireWire 1394a

**Light was provided by File X EZ-SyncLed device.