High Speed or Slow Motion cameras

High-speed Cameras are a special class of cameras that can capture 250 frames per second or higher, even up to 250,000fps to several million fps in some cases. If the high-end machine vision cameras above are for real-time processing, I'm thinking of high-speed cameras more for offline recording and viewing - a slightly different workflow. High-speed cameras are fairly uncommon in interactive installations because the (current) limitations of physics mean you can't watch reality in real time and slow motion reality at the same time. Years ago, getting cameras that could capture higher than 60fps were fairly specialized and uncommon, especially for the consumer market. Now almost every flagship smartphone can record 120-240fps and sometimes even higher in burst modes. Some standard webcams can also get up to 120fps. The primary market for professional high speed cameras is for industrial purposes, like the high end machine vision cameras covered above, or for the film industry. Since these applications are fairly niche and low demand, these cameras tend to be incredibly expensive - ranging from around $500USD on the low end to $30,000USD to $50k+ on the high end.

High-speed cameras typically work by continuously recording a circular buffer of frames into specialized on-board memory. When the camera receives a trigger to begin recording, that circular buffer is dumped and encoded into a regular video file that can then be downloaded off the camera or played back directly on the device. Depending on the resolution, frame rate and compression type, these files can be quite large, and can take time to download off the camera to process with software.

Another noteable thing to know about high-speed cameras is their light requirements. Because of the incredibly fast shutter speed, High-speed cameras require a lot more light than a traditional video camera. A traditional camera may only need to capture a frame every 1/60th of a second, while a high speed camera needs to capture a frame every 1/1000th of a second, causing a drastic reduction in the amount of photons hitting the image sensor. Filming outside in direct sunlight is usually the best option, but if you need to capture indoors you will need to use the correct type of light. Incandescent lights, flourescent lights, and other older styles of lights tend to not work for high speed because they actually flicker at a rate faster than the naked eye can see (typically at the 60hz of a standard AC power source). Using an incandescent light source with a high speed camera will often reveal the light dimming and brightening instead of staying steady. For high speed cameras, very large lights that can't cool down quickly enough to flicker or LED light sources for film production tend to be preferred. As usual, do your research on the light since not everything is created equal. Here is another source on lighting for high-speed filming.

Since high-speed cameras are really just great at pushing a lot of data through very quickly, youll find your tradeoff is usually between the desired resolution and your desired framerate. You can achieve very high framerates but at very low resolutions. These low resolution + high FPS videos

can be useful for scientific work (like analyzing ballistics, for example) but not so much for providing a high quality clip for a user.

Noteable high speed camera manufacturers are Phantom cameras from Vision Research, Photron cameras, and iX cameras, but their cameras can typically cost more than most interactive installation budgets can manage. Rental is often an option as well. The main issue you may run into with these cameras is actually interfacing with them. Because of their high cost and low usage in the interactive space, there often isnt a lot of prior knowledge out there about working with them and you need to have a camera before you can get documentation about their API's and such.

Around 2014, Edgertronic entered the high-speed scene with their more affordable high-speed cameras. Edgertronic cameras are basically a specialized FPGA with a Linux computer for additional processing and control. I used several of these on an installation in 2014 for capturing footage of participants at 720p and 400fps and they performed fairly well and were easy to interface with via standard http requests and a browser interface. Several models have come out since then with various improvements. Most other cameras out there also interface via a network connection to some proprietary control software.

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