

Topic no 48

Film Camera Mechanism

Ordinary cameras are brilliant for taking snapshots of the world. The only trouble is, the world simply won't "sit still"—there's always something moving around us, over our heads, or even under our feet. Fortunately, movie cameras can capture moving images that better reflect the changing nature of our world.

Persistence of vision": How the eye fools the brain

Open up a movie camera or **camcorder** (a compact electronic video camera) and you'll find all kinds of mechanical and electrical parts packed inside. But the basic science behind making movies has nothing to do with lenses, gears, electric motors, or electronics—it's all about how our eyes and brains work.

You've probably done that trick where you make a **flick book** (sometimes called a flip book) by drawing little stick people on the corner of a pad of paper and flicking them with your fingers so fast that they hop, skip, and jump. When your eye sees a series of still images (or "frames") in quick succession, it holds each image for a little while after it disappears and even as the next one starts to replace it. In other words, each picture leaks into the next one, so they blur together to make a single moving image. This is known as the **persistence of vision** and it's the secret behind every movie you've ever seen.

It's not just flick books that use persistence of vision. Before movie cameras and projectors were invented, 19th-century toy makers were using the same idea to make relatively crude animated films. A typical toy from this era was called the zoetrope. It was a large rotating drum with thin vertical slits cut into its outer edge. Inside, you placed a long strip of paper with small colored pictures drawn on to it. Then you rotated the drum to make the pictures blur together (just like a flick book) and looked down through one of the slits to watch them. Here's a great photo of a restored zoetrope by Andrew Dunn.

How Film Works?

It's a relatively small step from flip books and zoetropes to fully fledged movies. The theory of making a movie is just as simple: you take thousands and thousands of still photographs one after another. When you play them back at high speed, they blur into a single moving image—a movie.

A famous American photographer called **Eadweard Muybridge** (1830–1904) was one of the first people to show how one moving picture could be made from many still ones. Using multiple

cameras arranged in rows, he took series of photographs of galloping horses and vaulting gymnasts.

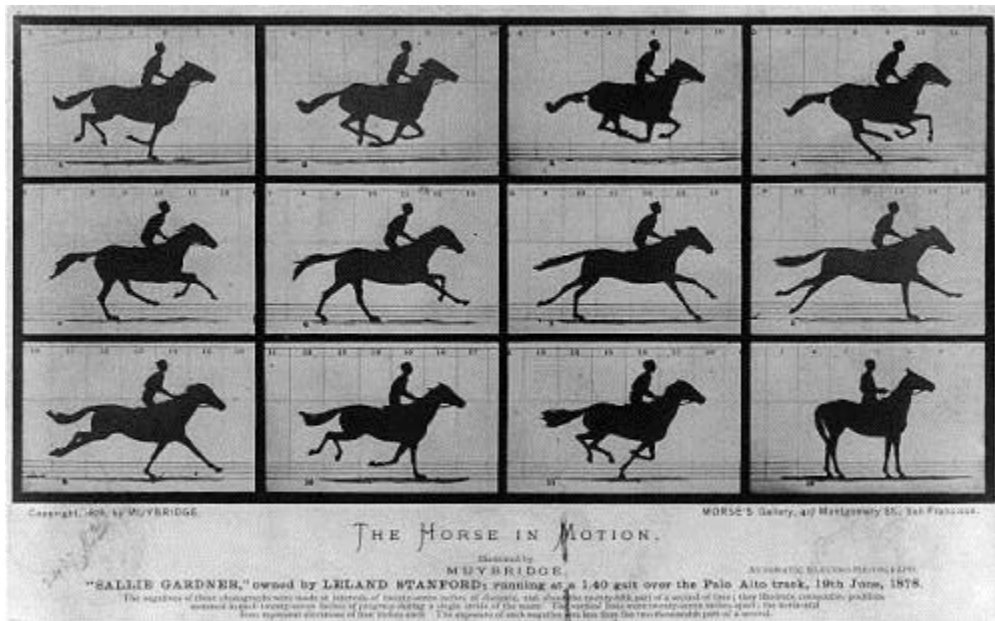


Photo: Few things illustrate how movies work better than Muybridge's amazing photos. Here's a sequence he made called "The Horse in Motion." Photo courtesy of US Library of Congress.

How movie cameras work

A movie camera or camcorder simply automates what Muybridge did by hand. Classic movie cameras are largely mechanical and capture images on moving plastic film; they're examples of what we call analog technology (because they store pictures as *pictures*). Modern video cameras and camcorders work more like digital cameras and webcams and capture images digitally instead (storing pictures as *numbers*).



Photo: At first glance, this old-style Arriflex film camera looks quite like a modern camcorder—but look closer. On top, you can see a big oval-shaped case where a huge reel of film is stored. If you were standing next to this camera, you would also be able to hear a motor inside whirring away as the film rattled through the mechanism.

Photo by Dave Maclean, courtesy of Defense Imagery

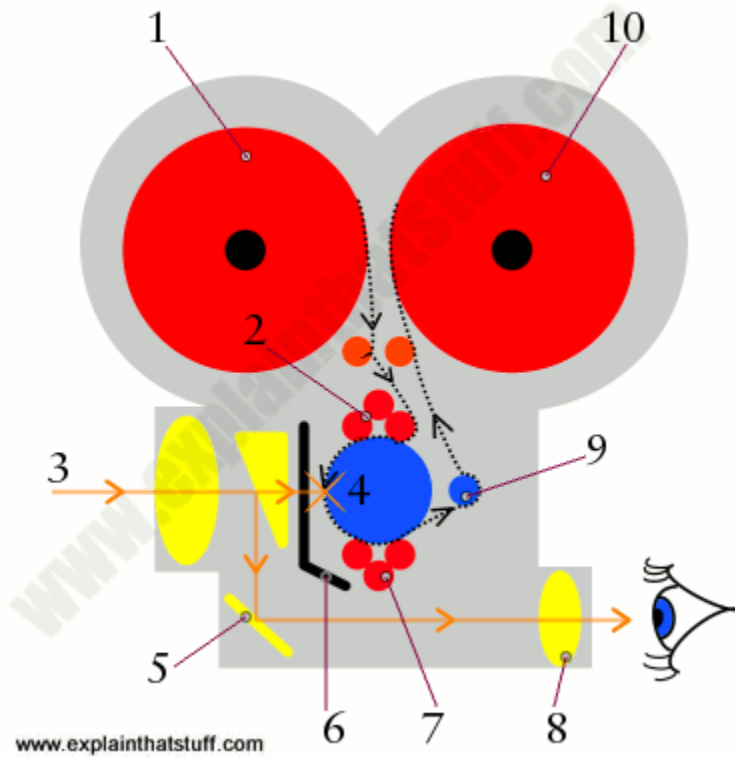
Classic movie cameras

A basic movie camera is like a standard film camera that takes a photograph on to plastic film every time the shutter opens and closes. In a standard film camera, you have to wind the film on so it advances to the next position to capture another photograph. But in a movie camera, the film is constantly moving and the shutter is constantly opening and closing to take a continuous series of photographs—about 24 times each second. Before modern camcorders were invented, people used mechanical home movie cameras, which were very small versions of professional movie cameras with all the parts (and the film itself) miniaturized. In these early cameras, the film was moved past the lens by either a wind-up (clockwork) mechanism or a small electric motor.

How a Classic movie camera works?

1. The unexposed movie film starts out on the large reel at the front. The film and its path through the camera are shown by the black dotted line and the black arrows.
2. The film passes over guide rollers and spring-loaded pressure rollers that hold it firmly against the central sprocket (a large wheel with teeth protruding from its edge, rather like a gear wheel). The sprocket's teeth lock into the holes on the edge of the film and pull it precisely and securely through the mechanism.
3. Light from the scene being filmed enters through the lens and passes into a prism (shown by the yellow triangle), which splits it in half.
4. Some of the light continues on through the shutter (black line) and hits the film, exposing a single frame (one individual still photo) of the movie.
5. The rest of the light takes the lower path, bouncing down into a mirror.
6. The shutter is like a mechanical eyelid that blinks open 24 times a second, allowing light through when each frame of the film is securely in place and blocking the light when the film is advancing from one frame to the next. The shutter is driven by the same mechanism that turns the sprocket.
7. More pressure rollers hold the exposed film against the lower part of the central sprocket. The teeth on the sprocket pull the exposed film back through the camera.

8. Light redirected by the mirror exits through a lens and viewfinder so the camera operator can see what he or she is filming.
9. Guide rollers take the exposed film back up toward the upper reel.
10. The large upper reel at the back collects the exposed film.



VIDEO CAMERA



CAMCODERS

When video recording was invented, photographic film was replaced by magnetic videotape, which was simpler, cheaper, and needed no photographic developing before you could view the things you'd recorded. Modern electronic camcorders use **digital video**. Instead of recording photographic images, they use a light sensitive microchip called a **charge-coupled device (CCD)** to convert what the lens sees into digital (numerical) format. In other words, each frame is not stored as a photograph, but as a long string of numbers. So a movie recorded with a digital camcorder is a series of frames, each stored in the form of numbers. In some camcorders, the digital information is recorded onto videotape; in others, you record onto a DVD; and in still others, you record onto a hard drive or flash memory. The advantage of storing movies in digital format is that you can edit them on your computer, upload them onto web sites, and view them on all kinds of different devices (from cellphones and MP3 players to computers and televisions).

How to make a movie with Digital Camera

Most modern digital cameras allow you to capture video as well as still photos, so you don't need a movie camera or camcorder to win an Oscar! If you've never tried home movie making with your camera, why not give it a go? Here are a few basic tips:

- **Preparing:** Make sure your digital camera batteries are fully charged before you start. Unlike still photography, which uses battery power only intermittently, making movies means your camera is operating continually for perhaps a half-hour or more—easily enough to drain your batteries at the most inconvenient moment. It helps to have fully charged spare batteries standing by.
- **Planning:** Unless you're making a spontaneous home movie, decide what you want to film before you start recording. You could even draw up a storyboard to help you plan

what to film and when. That way, you can record all the outside shots together, all the inside shots together, and so on—to save lots of moving around.

- **Casting:** Who's going to act in your movie? Friends and family? Or maybe you'll just talk to the camera yourself in a kind of video diary?
- **Filming:** Just like a professional movie director, be sure to record much more footage than you actually need. That way, you can edit down to a much higher quality end product. If you're working with other actors, record multiple takes of key scenes and choose the best ones when you watch them later.
- **Editing:** Explore your computer and see what video editing software (if any) is already installed on it. If you're a Microsoft Windows user, see if you have a program called Movie Maker installed. It lets you load files you've recorded with a digital camera or webcam and then edit them frame by frame, adding text titles and all kinds of other visual effects. The most recent version is called Windows Movie Maker and you can download it for free if you've not got it already. On a Mac, you can do the same sort of thing in iMovie.
- **Publishing:** Once you've recorded and edited your movie, decide what you'll do with it next. How about burning it onto DVD and giving it out to your friends and family? Or maybe you could upload it to YouTube or Facebook and become the next overnight movie sensation?

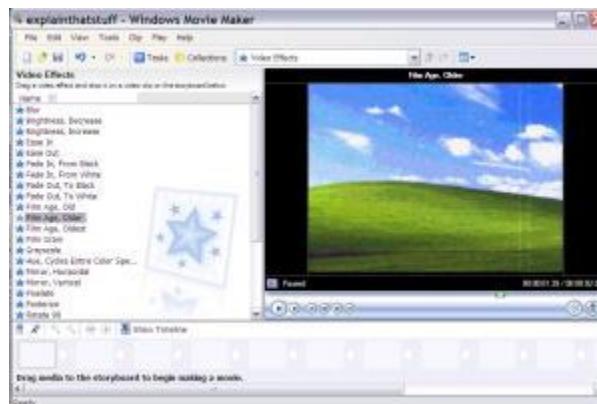


Photo: It's easy to add special effects to your movie with software like Movie Maker, a program packaged with most recent versions of Microsoft Windows. With a preview of your movie in the right-hand pane, you can click through a whole list of visual effects on the left, including transitions, fade-outs, and making your movie look old and crackly like a silent movie from the 1920s!