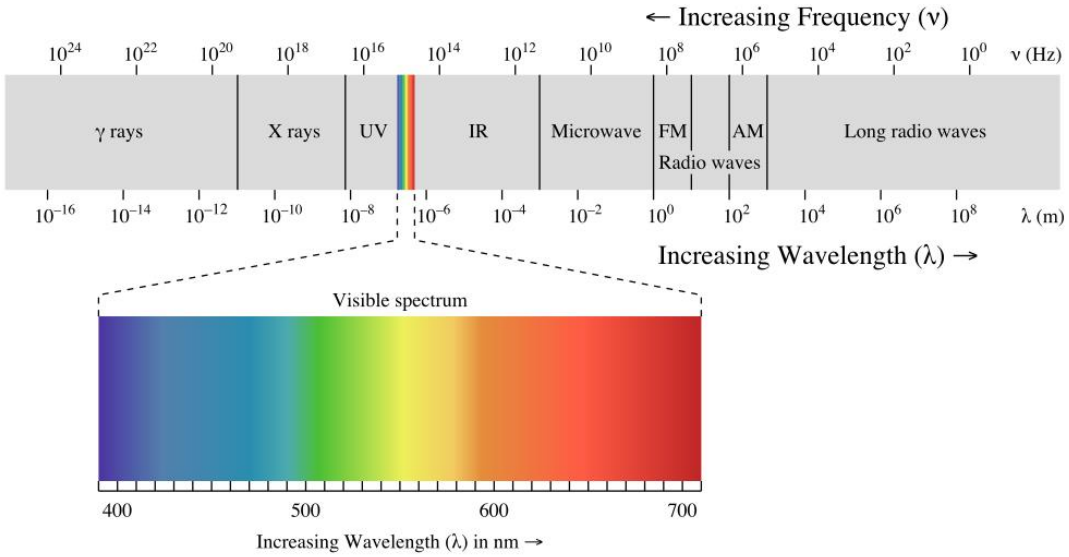
Infrared (IR) camera

Just like a normal digital camera, the Flir C2 creates its images by detecting light focused through a lens. The difference is that it does this both for normal (visible) light AND for infrared (invisible) light.

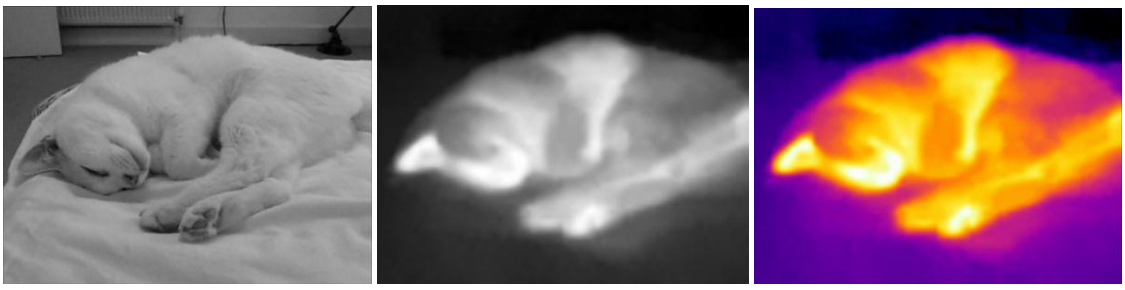
Very hot objects might glow in visible light. Pretty much all objects glow in mid-infrared (this requires less energy than visible light). Generally, the hotter they get, the more IR they emit.

Objects can also reflect IR, but you will find that these signals are usually overwhelmed by emissions.



Just as a normal black-and-white camera doesn't distinguish visible wavelengths (ie colours), the C2 doesn't distinguish between different IR wavelengths. It just measures the total intensity of light over all wavelengths from 7.5-14µm. Effectively it takes a black and white picture of the infrared world.

That said, you will find that most IR images have the different IR intensities colour-mapped. This means that the different grey tones from the black and white image are shown as different colours.



Louis the Cat in (i) visible light (black/white), (ii) infrared (black/white), and (iii) infrared (colour-mapped).

Colour mapping does not add any information. It just makes the differences in intensity clearer for the human eye. Colour choice is arbitrary, and usually chosen depending on which information is intended to pop out. Many people find this step a bit confusing, so it needs careful explanation.

Most people find it intuitive to just use red/bright for "warmer" and blue/dark for "colder", so it is suggested to use this type of colouring by default.

Physics info: emission and reflection

People often think the camera is measuring the object's temperature. But this isn't quite right:

- How much IR an object emits depends on its temperature AND how good an emitter it is
- Objects can reflect IR from other sources (eg the Mylar sheets act like IR mirrors)
- IR is absorbed by the air, so distant objects appear to emit less. And air can also emit IR!

The Flir C2 camera can be set for specific types of object to adjust for their distance and properties to allow more accurate temperature estimates. They are designed for use on building sites, so they might expect settings to allow for the different IR-reflectivity of eg metal struts, plaster wall etc.

Note that even cold things like ice will emit some IR radiation as they still have some heat (they are not at absolute zero).

Camera info: including a note about night vision tech

The camera by default will overlay information from the visible-light image to help outline objects in the IR image. You will see this mode when using the display on the camera's back.

Be careful that you don't present this type of image as being purely IR! Using the software, you can switch to displaying IR-only. Be sure to use IR-only mode to avoid confusion.

Some CCTV cameras and/or night vision set-ups use an IR spotlight/floodlight to 'light up' a scene. These IR-reflection images (aka active illumination) look very different to the images the C2 produces, the C2 images being dominated by IR-emission.

But before you rush out to buy yourself an IR torch, be aware that these active illumination set ups use near-IR, which is shorter wavelength than the C2 can detect. If you want to make near-IR images, you can do this by using a hacked webcam (remove the IR filter) to detect the reflected light. Else trying using a smartphone: these usually have some detection in the near-IR.

Possum lit by near-IR spotlight. See how the warm possum looks darker than the cool pathway, because this camera is picking up near-IR rather than thermal/mid-IR.

Night vision goggles work by detecting very low levels of visible light plus near-IR, and multiplying up these tiny signals. They create an image that looks very similar to a normal black and white visible light picture. Such images are often colour-mapped to green as the eye is more sensitive to green.

Demo ideas

For more camera-related but mostly non-astronomy educational demos, see https://www.techknow.org.uk/wiki/index.php?title=Infra_Red_Camera .

AstroBoost Project

The Royal Astronomical Society's AstroBoost project was funded by a STFC Spark Award and supported by project partners Guildford Astronomical Society, Hampshire Astronomy Group, Newbury Astronomical Society and the STFC's UK James Webb Space Telescope campaign. The project was managed and developed by Dr Jenny Shipway.