

Electronic painting

BY PETER DONEBAUER*

THIS ARTICLE aims to describe how the existing video hardware of a modest colour television studio has been used by the writer to develop what amounts to a new art form; where the pre-occupations are with the use and reasons for use of machinery rather than the technical performance of that machinery; where the aesthetics of an image become far more important than its quality, although the two are obviously linked.

I have been working over the last two years at the Royal College of Art Television Studio and have there been developing a form of expression midway between music and painting. This has become possible essentially because of the potential of television to provide an immediate feedback of picture and sound to the people controlling them. It is then possible to improvise the successive images and sounds in response to what has gone before. The result of this has been the development of a highly controlled moving pattern of light and colour, partially linked to an electronic music soundtrack. Both are recorded simultaneously on video tape and displayed on television monitors.

Although monochrome still photographs can only suggest what can be achieved, the accompanying pictures may give some idea of the potential imagery. I will outline how the studio is set up to function in an improvisational situation and describe how standard equipment, without expensive special effects apparatus, can be used to produce abstract imagery.

Close collaboration

My work is in close collaboration with an electronic music composer, Simon Desorgher, an ex-student of the Royal College of Music. We decide on some structure for the piece to be produced, usually in a visualised form. Our last completed piece was around the theme of the experience of a foetus inside a mother's womb. This moved forward by a series of contractions or expansions to the experience of birth, followed by a period of acquiescence dying back to sleep. The title of the piece was *Entering*.

A basic piece of electronic music was then created by the composer and tape taken into the television studio as a starting point for the work. The sound was fed through a physical transducer of my own design and construction to create a visual pattern depending on the frequency and amplitude of the sound.

This basic pattern is video taped with a monochrome television camera (or in this case with a colour camera operating in the monochrome mode). So we have a basic sound and a basic pattern.

Although a vast range of visual effects are potentially possible, we have so far restricted our use to those generally obtainable with standard studio equipment rather than specialised electronic devices such as video synthesisers. Standard effects include the independent colouring of images, chroma-keying, luminosity keying, and visual feedback loops, apart from the possibilities of telecine or electronic editing which are used more generally and can hardly be called effects. The application of these to the work being discussed will become clear.

Colour camera

The first important piece of equipment in the studio is the camera used to produce the images ready for mixing, processing, and recording. A colour television camera either consists of four tubes (one each sensitive to the three primary colours, red, green and blue, and one used for developing a luminance signal) or just three tubes for the primary colours. Each tube consists of a screen with a photosensitive layer. When light from the area being viewed hits this screen, it forms a minute electrical charge at that point. A pattern of charge equivalent to the light pattern falling on it is formed. And this pattern of light and dark is 'read' by a beam of electrons from the cathode gun in the neck of the camera tube. This beam traverses the screen in horizontal lines from top left to bottom right, neutralising the charge on the screen as it does so. A varying linear electrical signal corresponding to the light pattern is thus produced. The number of lines in the picture is 625 in the British system and these are scanned 25 times per second. And as the scan neutralises the charge pattern, the latter is constantly reactivated by the new light falling on it. A continuously varying picture is then transformed into a continuously varying electrical signal. This signal (or signals in the case of colour cameras) is fed to an area where it can be manipulated or merely made ready for recording and subsequent viewing.

In the studio, the colour camera is connected by a well-protected cable to the engineering control room where electronic adjustments can take place (as opposed to the usual camera operator controls of focus, zoom, pan and tilt of camera, and so on).

In the engineering control room are the alignment controls (which are usually set to give best reproduction and then left fixed) and controls over the iris, black level, primary colour levels, and a beam level control. Eleven variable controls on each camera. The effect of varying these controls can be seen on the monitor for each camera and also by referring to a visual display.

The iris control, as with any camera, adjusts the amount of light passing the lens. Its setting is usually fixed to be optimum for light situation, but it can be used as a fade control if so wanted.

The black level controls adjust the basic level of the video signal. There is a master control and one for each of the primary colours. Given a basic black and white picture, one can tint it in any possible colour by the manipulation of the black level controls. It is analogous to painting using the three primary colours (and indeed my work being described as 'electronic painting'). The difference is that the painter's pigment primaries are *red, yellow and blue*, whereas in mixing light the primaries are *red, green and blue*.

The gain controls vary the amplitude of the video signal from the base level set by the black controls. Though not strictly comparable (because of the means by which a television picture is produced) these controls are best seen as equivalents to black and white in a painter's palette. By somewhat different means they provide for a complete range of colours of differing intensity.

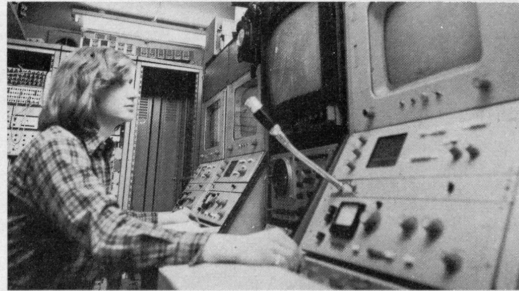
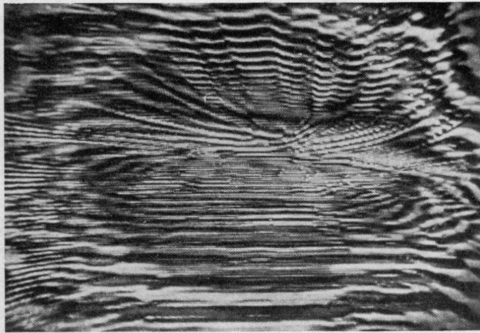
Constant reference

The function of the beam controls will be discussed a little further on. One has a constant reference as these controls are adjusted by watching the monitor pertaining to that particular camera. And by the display mentioned earlier, which gives an analysis of the image colour. For example, **fig. 1** shows the signals for one particular adjustment. The first curve shows red, the second green, and the third blue. One can instantly see a predominance of red. The black levels shown by the outside vertical lines show red at $2\frac{1}{2}$ units, green at two units and blue at two units. The gains are shown by the mountainous white areas and also indicate the predominance of red. The negative gain on blue shows an underbeaming effect described later. Visually there would be hardly any blue on the screen or none of any intensity. The display provides a quantitative check to the qualitative effect perceived on the monitor. It is extremely useful during production when colours have to be ready for images that have not yet appeared.

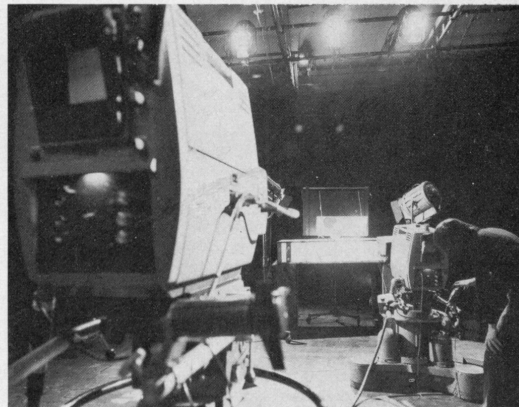
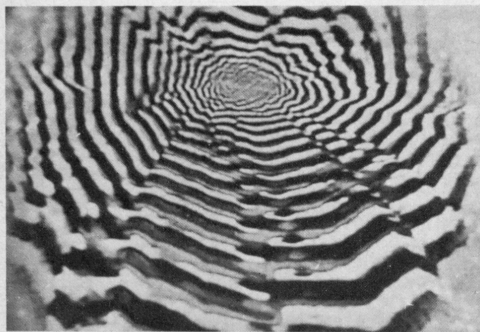
The overall tinting just described is useful but limited aesthetically. What can be added is the possibility of colouring different areas of the screen differently as in a traditional Japanese woodblock print. This is done by chroma-keying.

Chroma, or luminosity, keying (colour separation overlay as it is known in broadcast television) is an electronic keying switch designed to separate the perceived television picture into two components, one pertaining to a particular colour, the other everything not that

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▲ The author at the camera control desk.



▲ Philips PC60 colour cameras.



◀ Stills from the colour production 'Entering'.

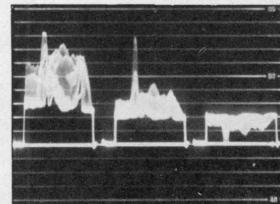


FIG. 1 ▶

colour. Or one pertaining to everything above a certain level of luminosity, the other everything below it. Practically what this allows is the feeding of the output from one camera into either side of this key operating on another camera. For example, broadcast television often shows a picture of the newsroom recorded by one camera keyed into the chroma key coloured wall behind the newsreader.

With the right equipment, one can have several layers of keying at different luminosity levels—all coloured separately. Used with a moving pattern of luminosity change, the effect becomes more interesting and can be compounded by varying the intensity at which the key operates while actually recording. This action, known as 'Tearing the key' results in an image that 'bleeds' at the areas that outline an image, where there is a fall in

luminosity level. It occurs particularly where there is a gradually graded field rather than a sharp distinction in luminosity.

The next effect to be considered is known as de-beaming or beam limiting. Basically, the electron beam that scans across the photosensitive coating of the television tube must be reasonably strong to cause a proper image to be produced. If

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this beam is weakened to neutralise the pattern of charge on the screen then the while highlight areas are the areas to first suffer, depending on the actual current available. The effect of this is to cause the highlights to appear masked out, lacking in sharpness and intensity. And for moving highlights to be retained, resulting in a prolonged smearing known as 'puddling'. This effect can be deliberately exploited and is known as de-beaming. In the colour television camera there are the three tubes, one for each of the red, green and blue primary colours. De-beaming is possible on each colour independently or any combination.

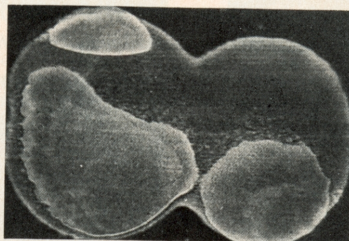
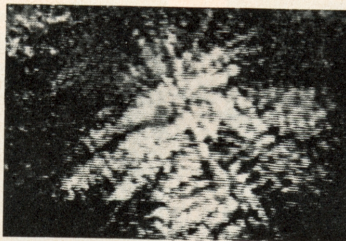
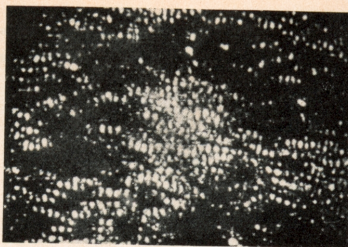
As an extension of the foregoing, one can adjust the beam current from a point of starvation to one of sufficiency. The effect of this is rather hard to describe, but the beam suddenly registers the slight backlog of that particular colour which lies residually on the charged screen. A large part of the screen suddenly reads, say, red and 'burns back' to the actual areas of highlight red that exist at that point in time. If the beam control is set around its critical point there will be a situation where there is a starvation or sufficiency of the beam, depending on the highlight intensity of the source being viewed by the camera. This can produce exciting effects with fields of changing intensity, particularly if all colours are set at this limiting position.

Visual feedback

Perhaps the most exciting of the visual effects possible with video tape is the situation of visual feedback. This phenomenon is probably better known from the audio situation where a microphone is placed too close to the loudspeaker playing back its own amplified output. A loud squeal results, due to some small random noise being amplified into the speaker, picked up by the microphone, amplified again through the speaker and so on through a series of amplifications. Similarly with a visual situation. If a camera is pointed at a monitor showing its own output, a squeal results but it is a visual squeal; usually an 'infinitely' repeated image reminiscent of the effect one gets between opposed pairs of mirrors: a picture of a picture of a picture. . .

But this is only the beginning of the situation. The exact graphic effect obtained depends largely on the relative alignment of the camera and monitor. For example, with the two dead on centre of their mutual axes there results a series of concentric squares or circles (in fact the shape of the television screen itself which lies somewhere between that of a square and a circle). If the alignment of camera and monitor is not along the axis, the picture is much less stable and appears to pour irregularly from nominally the centre to the screen edges. A different effect is induced if the screen is rotated at 90° to the camera-screen axis. This splits the screen diagonally into four segments each containing a similar image to the others.

As well as this, one can use several cameras shooting into the same monitor, displaying their combined outputs. Or feed the picture from another camera into the monitor along with the basic howling



▲ 'Entering'

▼ FIG. 2

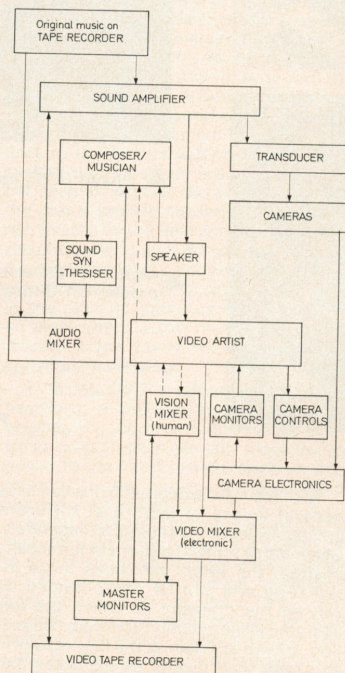


image. And so on, limited only by the equipment and mixing facilities available.

Along with all these so-called 'special effects' are the possibilities inherent in the telecine projection facilities available in television studios. This is basically a means whereby slide or film can be used as a source image for the video tape. It consists of a camera tube (or tubes, for colour) which receives a direct projection of slides and film. The resultant image can be keyed, coloured or de-beamed as with the usual picture from a camera.

This covers in a fairly simple outline the basic effects possible in a studio equipped with broadcast colour cameras. But it is in the complexity of mixing them all together and being able to control the resultant image that the difficulties (and fun) really lie. For example, keying and de-beaming a complex feedback situation produces very interesting results but they are hard to control. A television studio is designed to do a particular job. The concerns of this essentially lineal means of signal handling are picture stability, colour accuracy (especially between the several cameras being used), and so on. These facilities are not inherently designed for the creative exploration of moving coloured images. So the work done by someone such as myself tends at present to be a compromise with the equipment available. This need not be too limiting as a high degree of complexity is possible. But the care with which this can be controlled leaves much to be desired when using controls that have been designed for a completely different purpose. One ends up rushing along a control room trying to adjust widely separated equipment at the same time.

A colour television studio is a unique device for the instant production of moving colour images. It is in effect a very complicated electronic instrument that can be 'played' to produce moving coloured patterns.

Basic set-up

If we now return to the actual situation described at the start of this article, we had a set-up in the studio where a prerecorded music tape gives a basic moving pattern (in fact two patterns caused by low and high frequencies separately). As this pattern emerges, I 'played' the television studio to produce a wide range of colours and effects along the lines described earlier. The colouring and effects were carefully controlled to be relevant to the original aesthetic concerns and hence to the structure of the piece being performed.

At the same time, the music composer was in the studio with an audio synthesiser set to produce live electronic sounds. In response to what was on his monitor screen, and on the original soundtrack, he improvised to add another dimension of sound to the prerecorded one. This new sound mixture was fed back through the whole system (fig. 2) before recording took place and this affected what was happening on the monitor as well as the original sound.

So one had a situation of constant feedback between one person controlling the sound (and consequently affecting part of the image), and another person controlling the image in terms of colour and effect. It was this situation of improvisation of sound and moving colour forms simultaneously that made for a

unique new art form.

Each run through or recording of the piece is a unique improvised performance which, though basically following the same form, allows considerable variation on the theme. The music at present tends to vary less and the picture much more between each 'take'. Several takes were recorded and the best selected for subsequent viewing. Exceptionally, editing takes place. Editing here tends to detract from the fact that each take is a live improvised performance recorded in real time. Thus a 10 minute piece is made in 10 minutes though after weeks of preparation and days setting up and rehearsing.

Communication gap

One of the major difficulties of this area of work is in the communication gap between the artist, his ideas and fantasies, and the television engineer's ideas. For example, the television engineer expects the image to be relatively free of 'noise' (a random activity on the screen unrelated to the information being transmitted by the system) whereas this same noise could quite easily be used by the artist as an expressive agent. What is noise for the television engineer can thus become information for the artist using the medium.

The studio usually allows for a degree of creativity from programme makers, within certain well defined limits. But these limits are essentially an arbitrary convention continued through habit and convenience. Conventional television producers or directors are in fact out of touch by about 50 per cent with the final image because they leave it to engineers to maintain a certain visual quality that is consistent with arbitrary professional standards. This is generally thought not to be a bad thing because it theoretically 'frees' the producer/director to concentrate on the content. Unfortunately, as anyone who has studied art will know, content form and technique are inextricably linked and feed off one another during creative activity. By setting professional standards of image quality, an immediate 'sameness' is introduced into television programmes.

If one ignores the ideal of image quality, one immediately frees oneself of all sorts of arbitrary restrictions. For example, a completely desaturated washed-out picture that one never normally sees can be used at the right point to indicate some internal feeling or state in a unique way. Similarly with a picture that is hardly perceptible due to low luminance or seems to have nothing on it at all. Or where one or more of the colours are deliberately misaligned from 'normal'. For

example, in my last work, a certain section had an image keyed in with a deliberate time delay of several microseconds. Which effectively changes the colour values in the picture from saturated primaries towards desaturated colour mixes. And it is interesting to note that this was achieved using equipment solely designed to *correct* unwanted timing errors that sometimes creep into the system and prevent accurate recording.

What I have tried to do is free the system of some of its own traps. A completely new art form unique to television is possible. Whereas television has always risked becoming enslaved to the aesthetics of the film medium. In fact broadcast television has tended to set standards that others try to imitate, although hopelessly out-financed. This is particularly seen in art schools and polytechnics, many of which have small studios that are under-used because they were set up to allow imitation of broadcast television styles that they cannot hope to compete with technically.

Subsidiary role

The uses for television as an art form in its own right are very wide and this article has merely elaborated one possible direction. My own reasons for using the medium in this way started while I was studying and making films. I have been very dissatisfied by the subsidiary role played by film music in the original planning and execution of the average film. Invariably it is tagged on as a final event during film production, yet even at that stage has a profound effect on the meaning and flow of images. So, using film, I attempted to enhance this effect by *starting* from the music. This was either composed before or during the period of shooting and the film then edited to the music. This process was successful up to a point but tended to lack spontaneity. The link between music and image could have been stronger and there really needed to be some way to adapt the music to the images during the editing process. All this became possible using the newer technology of television as I have described.

What I also have been trying to achieve through this work is an integration of natural processes with the advanced technology that we are surrounded by. For example, Richard Monkhouse in his recent article on electronic video synthesis (December issue) ends by pointing out the importance of camera feedback. 'The re-cycling transformations that it can produce can barely be done electronically at the moment.' The interesting thing about video feedback is that it occurs 'by itself', which is to say that we have no

direct control over what happens. Some degree of control is possible in the general sense by positioning the cameras and monitors similarly but no direct prediction is possible. One cannot help but notice that powerful configurations reminiscent of certain natural forms often result. I see the feedback loop as one example of a natural growth pattern, similar to the way some shells build up or a population explodes.

Meaningful form

The problem for the artist is to channel such processes into a meaningful form. This is perhaps more easily understood by considering an abstract painter such as Jackson Pollock. The flow of paint is very carefully directed by the painter across the canvas in accordance with his inner criteria of what is 'right'. This refers us back to the problems of professional standards discussed earlier. What is right for Pollock might not be right for the teacher of a life drawing class. Nor need what is right for a video artist be right by technicians' usual standards.

To work in this field requires a sympathetic open-minded technician, which is surely one of the reasons why serious work of this nature has not come from inside any of the broadcasting companies. There are many other reasons of course, such as high costs of using sophisticated machinery to do things that could be done far more simply. And in particular the lack of imagination in those people who exercise administrative or other control over the equipment, whether on management or union sides.

It is very easy to produce interesting graphic effects via the television medium, as it is very easy for most people to learn to draw. But it is the attempt to mould those effects into a meaningful whole that is the challenge. ■

Acknowledgments

The work discussed would not have been possible without the sympathetic support of Stuart Hood (Professor of the Royal College of Art School of Film & Television) and Reg Clough and Neville Horsefield, engineers at the same establishment.