

VISIC: A Scoreable Keyboard Color Music*

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Abstract

This paper describes a system to create a video color music that can be scored like music and played on a standard electronic keyboard. Here called "VISIC" the program generates a great variety of multi-colored visual shapes that are propelled through video space on a computer screen for a limited length of time. The shapes or lines or planes interact in a systemized manner until they disappear, much like musical tones or chords. A notation convention allows VISIC ideas to be composed, replayed at will, and preserved for future rendition. A VISIC composer can therefore create new VISIC for real-time performance and artistic development.

Introduction to Early Color Music

As the technology for handling light and controlling the visual field evolved, so did attempts to create a color music. Early systems used light sources projected through color filters, lenses and mirrors.[1] Through the centuries many instruments were invented to perform color music, most notably the light system for Alexander Scriabin's tone poem Prometheus; and later Thomas Wilfred's Clavilux.[2] One might say that the origin of abstract painting, as begun by Vassily Kandinski, followed another impulse to create an abstract visual music, albeit static.[3] Perhaps the most sophisticated and successful visual music-like development was made with abstract films. Hans Richter in Germany around 1920 tried to emulate sonata form by developing visual themes like a Chinese scroll; he photographed painted glass a frame at a time, and completed many beautiful abstract moving pictures he called "absolute film." And of course there is Walt Disney's abstract rendition of Bach's Toccata and Fugue in his 1940 Fantasia. The Canadian Norman MacLaren has continued this impulse, painting abstract images directly on film, for example his beautiful Spheres created in 1970.[4] More recently music-driven color lasers project interesting

patterns on the wide overhead screens of planetariums; but their symmetries and linear curlicues, while very pretty, fail to fascinate for long. With the advent of the computer and high-definition color monitors one would think that color music would be a natural, but most attempts seem to end up as screen savers! The work of Tom DeWitt and J. Whitney, Sr. are the most serious attempts to turn digitized television imagery into something approximating color music, minus the rigor of a systematized harmonic color structure.[5] Despite this long history trying to exploit the obvious analogies between music and lambent color forms, none seem to me to rise above the curious. Color music remains an oddity with little emotional appeal. Why? The very beauty and human meaning of music is what has led many to wonder whether or not we are missing out on another equally powerful artistic medium in designed, moving color shapes. Color like sound is a sensual phenomenon that exists and has human meaning only when perceived. There are of course many differences. Color has to cover an area, a thing, whereas sound is ubiquitous. We are conditioned to accept sound as something natural: the range of the human voice, animal cries or bird song, the percussive sounds of nature and the rhythms of motion. There is no natural given way for us to exert control over color per se, and a viable syntax of color is lacking. Musical instruments are there for us throughout our childhood, and we hear instrumental music all our lives; many of us even learn how to play them at an early age. Color is there, of course; crayons and watercolors are provided in grade school; but there is no methodology for the learning of how color can be controlled and manipulated (unless we become artists, but even then color or design theory is usually taught as an afterthought).[6] The human senses of sight and sound are susceptible to definite and highly complex organization in space in time. Sound in nature is limited (bird calls, wind and sea and earth movements); but the world of sight is vast and inexhaustibly rich. In music we are able to organize sound, beginning with artificial means to create tones and textures; but it is a universe that is largely self contained and independent of rational thought.[7] Sight, however, pours an infinite wealth of information into the human intelligence that contributes to our major judgments and rational ideation. Although nature organizes color in the form of flowers, aurora, sunsets, crystals and other naturally designed phenomena, the very complexity of the visual world seems to prohibit the generation of anything as simple as music. Musical tone combination, however, is formulated in great detail, and composers study it as a matter of course.[8] Theories of musical harmony and counterpoint developed some time in the sixteenth century well after the invention of musical instruments.[9] A viable color musical instrument must precede the

development of equivalent theories of color music harmony and counterpoint. The psychological effects of colors in various combinations, therefore, depend on such an instrument, and are to be discovered after considerable experience using it (and, perhaps, altering the initial assumptions).

Toward A Color Music Medium

While I have not actually implemented VISIC on a computer-midi system (lacking the equipment and computer know-how -- with the caveat indicated in reference [15]) I offer the idea as a prolegomenon to such an operational system. If an abstract color medium could be developed, one would think that the human emotional response would be even more powerful than listening to music since the eye digests considerably greater gulps of information than the ear. All of the psychological effects which music plays upon our brains through our ears would a fortiori impact our consciousness through the eye. For example, the delight of design; the anticipation of reoccurring patterns; the resolution of chaos into order; the pleasure of completion or closure; the weakening or strengthening of a pleasing form by repetition; all unexpected deviations from expected norms as delightful surprise elements.[10] There does not seem to be any inherent physical or psychological reason why all these phenomena should not affect us visually as music does--witness our reactions to fireworks, for example; or kaleidoscopic forms. As an artist I have employed all these effects in a non-objective art form I originated and call "schema".[11] My many years experience creating this static form of abstract color forms convinced me that the only thing lacking for a color music was the means, a malleable visual color medium; a neat, simple way to turn colored and abstract visual form into something that can be formed, captured and repeated (without the necessity of learning how to use a complicated computer program). I always felt that when such a means was discovered, the creative communicative use of real-time visual forms would make available another important medium for the development of human aesthetic values.[12] I do not intend in this paper, however, to explore the aesthetic possibilities of my color music--merely to describe a possible way to realize it. In the light of the many attempts to discover exactly what aspects of human vision can be exploited to discover something akin to music it might

seem foolhardy to try again. But it seems inevitable to me that some type of color music will eventually find its way into the world as a viable art medium. Our children are conditioned to appreciate abstract color shapes and forms by constant exposure to their video games and special-effect filled movies. I think I have discovered a way to program a computer to control moving shapes racing across a video screen. I call it VISIC, and it differs radically from previous color music systems. Neither is it like color animation systems that use a mouse or other types of manual inputs.[13] In my idea ten simultaneous computer inputs can be made from a piano-like keyboard (the ten fingers of the human hand).[14] And because I use conventional piano music scoring, a musician trained to read piano music can sit right down and immediately "play" VISIC. Although the VISIC program I came up with is versatile, it is clear to me that it is just the first step. I have chosen a restricted group of conventional shapes or forms (here called "objects") and limit the ways they can be manipulated in real time. Although computer technology is sufficiently advanced to allow for the introduction of recognizable images (from video tape, CD-ROMs or scanned slides), and to manipulate them exceptionally (for example the way things are "morphed" in science fiction motion pictures), their complexity and arbitrary orderliness prevents integration into a system of VISIC with any expectation of universality. Accordingly, a VISIC using recognizable objects is beyond the scope of the present paper, although the techniques suggested here might apply.

Creating Time and Motion in Color Space

In music time is of the essence. How can time be captured in video to enable the production of a viable VISIC? How can we turn on color shapes and enable them to pass through and reverberate throughout a "space" for a definite length of time? This is the principal problem for any color music. I have long argued with my composer and computer-savvy son Erik that color music is possible, but he has always been skeptical (even though we set up a system for turning music into color lisajoy patterns, converting an old color television set, and creating patterns not unlike modern color laseriums).[15] I decided to press him on the issue by writing the first draft of this paper. I had no idea how to do it, only a vague intuition that it must be possible; and he patiently read the first draft and sent back his comments. By the second draft, thanks to his trenchant

criticisms, I had thought up the generic idea that makes it all possible: periodically moving shapes through the space of a video display where they can commingle in particular ways. Commingling of tones is an aspect of music that makes it music: simultaneous sounds interact and generate harmonious or dissonant effects. I knew that objects in any viable VISIC must flow over and about one another. To flow across a screen is the visual analog to the flow of sounds in music.[16] As objects move, they must, of course, effect each other; they must especially influence their mutual colors and generate harmonious or clashing effects; but also their combinatorial interactions should create new object imagery (a novelty which VISIC provides that is beyond music). I realized that I had solved the problem for a viable color music: first, objects must originate somewhere on the screen; their hue, intensity and color saturation must be controllable the instant they appear; next, they must be propagated across the screen at a controlled rate or speed of "motion"; finally, their manipulation along their pathways on the screen (or through a virtual volume, if the screen is given a third dimensional aspect) must be formulated in great detail. The interactions of variously shaped, colored and manipulated objects, moving through video space, is what generates the overall effect of VISIC as an art form analogous to music. Finally, a notation system must be given to provide a technique for writing down every step of VISIC composition.[17]

Color Considerations

Although the near microscopic colors of the screen of a typical video monitor, whether phosphor, liquid or other matrix screen display, are restricted to red, green and blue dots, the present VISIC program has twelve color changes, each of which are formed by various combinations of these three tiny display elements. The convention used here is to break the color spectrum down into the Newtonian color pie, but with twelve slices: red, red-orange, orange, yellow-orange, yellow, yellow-green, green, blue-green, blue, blue-violet and violet, analogous to the twelve tones of a musical scale. Colors in nature add or subtract in certain ways: due to the chemical properties of color media when mixed physically; due to reflexivity or juxtaposition; or as a result of color separation when light passes through overlapping colored objects (especially color filters). In the VISIC program the twelve colors are essentially virtual colors because they are originated by

various combinations of the red, green and blue phosphors. Therefore, when any of the twelve combinational colors are juxtaposed, overlapped, or otherwise intermixed, the color interactions of objects on a VISIC screen all occurs in the eye. Thus analysis of VISIC color underactivity can proceed independently of the physical phenomena which give rise to them. Suffice it to note that as the human ear responds to the tones of music in different ways, the human color perceptual device, our eye, has a spectral sensitivity which gives some colors different "weights" or strengths. In addition to our eye's sensitivity to color hue, the saturation and intensity of colors affect us in different ways. If harnessed systematically it is clear that color can be turned to aesthetic account (as every artist knows). Considering hue alone, for example, we barely discern colors at either end of the spectrum, namely purple at the high end and red violet at the lower end; and one might say that these colors are appropriately heavy and dark. As we approach the center of the spectrum, the eye's sensitivity increases; and in the vicinity of the yellow-greens the colors become strong, light or thin. In addition red seems to be a universal all cultures respond to (and is the first color many languages name after black and white).[18] Next the eye responds to certain colors as inverses of each other, the so-called complementary colors: red and green, violet and orange, yellow and blue. Other combinations of colors such as triads seem to have a certain visual perceptual logic: for example the triad composed of red, blue and yellow.[19] In the present VISIC program objects can be solid, or their area can be splintered into a mesh of pointillistic dots (of variable openness). When two solid colors are side by side they influence our perception of each; and if they are broken into a perforated sieve, they share an additive pointillistic interaction. Thus color harmony (or dissonance) becomes possible in VISIC, since the objects, flowing over the screen or into the space of the display, interact color-wise (as they also interact shape-wise, suggesting the beginnings of an equivalent to musical counterpoint).

Object Definition

What objects comprise the repertory of shapes in the proposed VISIC program? Shape is less easily generalized than color (we might call harmony and counterpoint the shapes of music), and less rigorously given a hierarchic value or a contrapuntal relationship. To discover something

analogous in the visual realm my experience as a visual artist gave me a hint.[20] Artists know that rectangles have the most emphasis within the frame of a picture, because their sides echo and enhance the edges--a minor form of order, of visual harmony. Artists attach great importance to frames because they serve to capture and emphasize this rectangle outlining force. The repetition generated by planes, ribbons, horizontal and vertical lines are forceful visual elements, since they all generate repetitions of the frame of a picture.[21] VISIC therefore should contain at minimum ribbons, rectangles, planes, horizontal and vertical lines. Beyond these basic elements there is little psycho-physical justification for any geometric object in terms of its visual strength or power on the mind. Short of employing a comprehensive fragile geometry that produces all shapes,[22] the best that is possible is to choose a group of conventional geometric elements whose familiarity provide an obvious repertory of images with a certain manipulative convenience. I therefore chose as the initial objects for the VISIC program (in addition to ribbons, squares and lines), triangles, circles, dots, spirals and sinusoids. These shapes permit a wide range of interactivity, especially when they are mixed together, altered in size, or otherwise changed in their relationships. Another feature I thought necessary as an integral aspect of objects is to distinguish their leading and trailing edges. In music the overtones and impulse nature of sounds is what distinguishes which particular instrument is being played (for example, if you eliminate the initial attack effects of many instruments you cannot tell them apart). I therefore provide the leading edges of all objects with a distinguishing quality, and their trailing edges with a diminution of color. Thus the ribbon or square has a bright leading edge of the complementary color (in whichever direction it may be travelling), and its trailing edge fades away. (Many variations are possible: tear-drop shapes, arrowheads and tail feathers, cusped leading edges and snailed trailing edges, different colors for leading and trailing edges, and so on.) All objects introduced are also distinguished by their leading edges being tipped with its complementary color, and their trailing edges fading away. Thus all shapes moving across the screen are distinguishable as to their individual nature, much like the tones of musical instruments.

Space Articulation Within VISIC

Since the flow of time is simulated in VISIC by the objects moving across the face, or into or out of the screen, a kind of color motion space is therefore established through which all objects flow, and in which all objects are manipulated, colorized or otherwise effectuated as they overlap and interact. The strictness of these activities and their definite interactions are what begins to formulate a new type of visual color music. When the system is turned on it operates in a default mode in which all visual activity occurs on the front plane of the VISIC screen. Objects can also be made to travel into a virtual three-dimensional depth, permitting a broader range of manipulative activity than would be possible in two dimensions. The conventions for the division of space used for VISIC is to place introduced figures and objects directly on the picture plane. Objects can be keyed to move backwards toward the vanishing point at a point one-third from the edge, or two-thirds from the edge, keyed in as indicated in Table I. The space is always boxed in with a faint grid. Objects flow from where they are conventionally introduced (complementary colored leading edge first), to the right side of the most distant back plane, trailing edge fading away (unless keyed to move differently, as indicated in Table I). The VISIC program permits the instant change of the path of any object before it begins travel over the screen or through the VISIC space (for example from back to front or from top to bottom, controlled by means of key actions shown in Table I), but not during its motion (an option considered but rejected because of its complexity).

TABLE I: VISIC PROGRAM KEY ACTIONS

(See Note below for defaults)

KEY	ACTION	DESCRIPTION	KEY ACTION
F#	= Undo	Undoes previous key	One shot
F	= Interact	Makes shapes interact	One shot

E = Slows speed	Slows speed	As long as held
D# = Increase speed	Increases speed	"
D = Tempo 4/3	Changes 4 to 3	Toggles
C# = 3D/2D	Changes 2D to 3D object	[Applies only
C = Over/under	Reverses over/under	when object is
B = Color reverse	Colors background/object	keyed at the
A# = Reverse motion	Reverses motion	same time.]
A = Wipe/unwipe	Trails color across screen	"
G# = Enlarge/shrink	Enlarges/shrinks object	As long as held
G = Grain open/close	Increase/decrease grain	"
F# = Needle/solid	Splinter needle/solid	Toggles "
F = Pointillize/solid	Pointillistic/solid	"
E = Rotate c/cc	Clockwise/CCW	Speeds as pressed
D# = Undo rotate	Stops rotation	One shot
D = White	Colors object clear	Persists as long
C# = Yellow	" yellow	as appears.
C = Yellow-orange	" etc.	"
B = Orange	"	"
A# = Red-orange	"	"
A = Red	"	"

G# = Red-violet	"	"
G = Violet	"	"
F# = Blue-violet	" [Note: Colors grow	"
F = Blue	" increasingly	"
E = Blue-green	" intense moving up,	"
D# = Green	" and increasingly	"
D = Yellow-green	" desaturated moving	"
C# = Yellow	" down. Leading edge	"
C = Yellow-orange	" with thin complement	"
B = Orange	" -tary color; trailing	"
A# = Red-orange	" edge fades. Applies	"
A = Red	" to all objects.]	"
G# = Red-violet	"	"
G = Violet	"	"
F# = Blue-violet	"	"
F = Blue	"	"
E = Blue-green	"	"
D# = Green	"	"
D = Yellow-green	"	"
C# = Yellow	"	"

C = Yellow-orange [Middle C] " "

B = Orange " "

A# = Red-orange " "

A = Red " "

G# = Red-violet " "

G = Violet " "

F# = Blue-violet " "

F = Blue " "

E = Blue-green " "

D# = Green " "

D = Yellow-green " "

C# = Yellow " "

C = Brown " "

B = Circle Circle Each new object key

A# = Dot Dot stops previous object,

A = Vertical line Vertical line including default ribbon.

G# = Horizontal line Horizontal line "

G = Triangle Triangle "

F# = Sinusoid Sinusoid "

F = Spiral Spiral "

E = Square Square "

D# = Enter bottom Enter bottom ctr Toggles, and applies only

D = Enter right Enter right ctr to instant object.

C# = Enter top Enter top center "

C = Enter rear Enter rear center "

B = Z = 1 Create shallow space Applies until rekeyed

A# = Z = 2 Create deeper space otherwise.

A = Z = infinite Distant space a point. "

Note: Default initiated when any color key is pressed, producing a ribbon of that color broken into dots and traversing the front of the screen at a rate of 1 per second, its leading edge with a line of its complementary color, its trailing edge fading. The instant any other color key is pressed it releases another ribbon that enters left and flows right, successive objects being narrower and brighter going up the keyboard. The ribbons all disappear on the right in the reverse sequence entered at the rate of 1 per second (changeable, of course, by other key actions).

Keyboard Functions

Control over everything in the VISIC program is by means of keys on a conventional electronic piano-like keyboard. Using a MIDI keyboard interface,[23] keys can be set to toggle (flip-flop); to turn something on that remains on; or to cause an action as long as they are pressed down. (Although MIDI programs also register the speed of pressure, this capability is not used here, but it could be used to cause texture or other changes.) I have tried to group keys to facilitate playing

VISIC, although experience will certainly suggest a better arrangement. Table I lists all keys on an electronic keyboard with descriptions of their actions and restrictions, and exactly how the keyboard is partitioned with respect to a music notation score, and their individual actions.

VISIC Notation System

Notation in VISIC is by means of the conventional music score. Every note on the score indicates an action in the program. When a specific score is read through it causes the appropriate object introductions, their colorizations, the ways the object moves, how it is manipulated in real time and interacts. These interactions are all arbitrary and to be learned how to control meaningfully with experience. Some of the actions are temporary and are countermanded if that key is pressed again (flip-flopping); others are impulsive and one shot; some act only when a key is pressed; and others remain in effect unless countermanded by another key action. A key permits the given shapes to interact with one another, for example if sinusoid and square are indicated, and the "interact" key is pressed, the square will jiggle up and down sinusoidal. As listed in Table I, three registers of the keyboard establish the color of all introduced objects (from middle C one octave down, and two octaves up). As suggested here the lower colors are less intense than the upper ones that get brighter and brighter. The lower keys control the entry of particular objects (here given as, but not limited to, circles, dots, lines, triangles, sinusoids, spirals or squares -- all of which can be determined when VISIC is first programmed). The lowest color keys produce objects that fill the entire screen; and going up successive color keys introduce increasingly smaller and brighter colored objects (to permit overlapping that makes any sense). The default for all colors is to break their areas into small, pointillistic dots. Thus overlapping objects can be seen through one another. (A key is provided to underlay any object, and another key permits changing the degree of openness, as listed in Table I.) Default conditions pre-establish the initial VISIC action. Nothing occurs, however, until some color key is touched. When any color key is touched a solid-colored ribbon, of that color, moves across the face of the screen, entering at the left and moving to the right, at a tempo of four beats per measure, and at a metronome rate of 60 (one beat per second). Note that many color harmonies and dissonances will occur as the various objects overlap or

interact in their adjacent areas, especially when they are splintered into needles or pointillistic areas.. Every ribbon is automatically given a thin complementary color leading edge, and the trailing edge fades away. After a second any ribbon has moved across the screen, disappearing at the right. The rate of passage can be sped up or slowed down by a key action; or changed from the default tempo of four beats per measure to three beats per measure. Other objects can be keyed in to override the default option by hitting any key at the bottom of the keyboard, as shown in Table I. But a different object than the default ribbon must be keyed in at the same instant some color key is pressed (within a small epsilon of time differential to allow for imprecise fingering). All objects enter from the left center, like the ribbon, unless keyed to enter elsewhere, their leading edges just peeking onto the screen the second they are keyed in. Again, all other objects are wide and darkly colored when keyed at the bottom color key, and appear narrower and more brightly colored as they are entered by the upper keys (unless they are keyed in to enter from the rear plane, in which case they enter small and exit large). Changes must be entered at the exact time (within the epsilon time differential) any given object is initiated by touching the appropriate key at the approximate same instant the object key and its color key are pressed. Top keys on the keyboard permits manipulation (as well as the tempo and speed control). All objects may be enlarged or shrunk; traced or wiped across the screen space (coloring the entire path through which it flows); or reversed in motion (to go back or forward). They can be made to bounce around longer than its allotted tempo/time span; to reverse the color from the object to the entire background; to be un-pointillized or un-splintered; or to be swirled clockwise or counterclockwise, etc. Following are a few examples that illustrate typical VISIC session, beginning to end:

1. Default Mode (Settings as indicated in the Table I Note):

When the system is first activated the screen is blank. Now suppose you press middle C on the keyboard and hold it down. C is the key for yellow-orange, as indicated in Table I. A swath of yellow-orange emerges from the left of the screen and passes to the right, coloring the entire screen; the yellow-orange swath remains there until the key is released, at which time the trailing edge slowly moves across the screen, and after a second passes out of sight on the right.

2. Object Introduction

When the system is first turned say on you want to introduce a Circle in Red, have it enter from the top of the screen, and intersect after a moment with a Blue Square coming up from the bottom of the screen, to create a red-blue purple figure. First, the low B on the Bass Clef is pressed (Circle, as shown in Table I); the high A above C above Middle C is pressed (Red); and simultaneously the Low D-sharp on the lowest Bass Clef scale is pressed (enter from the top). At this point, if you keep all these keys pressed, a red circle will proceed from the top and float down. Next, after a few moments, pressing the square key in the low E Bass Clef, the blue key F above middle C, and the Bottom Enter key low D sharp will bring up a blue that proceeds upward and collides with the circle to meld into purple (continuing as long as all keys are pressed)

3. Object Manipulations

Continuing with either of these examples, the ribbon or square or circle (or any of the other figures provided, as shown at the bottom of the Table I) can be manipulated, altered, texturized, or otherwise manipulated. For example, if the splinter key, the high F sharp, is pressed, all the figures can be broken up into small splinter like areas. This and other texture variations are introduced to provide for more clearly-defined color mixing.

4. Using Conventional Music Scores with VISIC

Since VISIC notation uses a conventional music score, all music can be entered directly, sometimes with surprising results. (Since the keyboard is a MIDI interface it can be programmed to produce actual aural sounds along with any VISIC display.) For example, if a Bach Two-Part Invention is played, a series of interesting images could be introduced appropriate to the music. Say that a VISIC performer decides beforehand which objects might work for this music. Keys that would introduce these objects, and various ways they might be manipulated, would be indicated on the score (with an appropriate symbol on the score). If, for example, the decision is to cause the introductory theme to show as a series of green spirals that enter at the rear of the screen and proceed forward, appropriate keys are pressed; and if the spirals are to be met with red-orange sinusoids that come from the rear of the screen, again using keys as shown in Table I.

Conclusions

The VISIC program proposed here is a color music system that articulates objects in a video space in a systemized and interesting way. Video space in the program is displayed on a video color monitor, but it would also apply to virtual reality systems using 3D goggles, laser projection or other display systems. In the VISIC program all inputs are restricted to the electronic keyboard with an appropriate MIDI interface, so that each key acts like a switch to key in an appropriate VISIC function. The VISIC program provides a system of notation for the real-time performance of VISIC; a notation system that codifies every aspect of its use, allowing the interpretation of the color musical ideas created by a composer.[24] There is of course no inherent limitation to using the VISIC program extemporaneously, as many Pop or Jazz musicians improvise with their instruments. In addition, it can be imagined that duets or other combinations would be possible, up to and including an entire orchestra of instrumentalists. As with the instruments of an orchestra, a symphony would be formed of tailored VISIC programs that control unique visual domains, analogous to musical instruments with different timbres. For example, musicians at separate keyboards could introduce splashes of dots, or vortices of whorls; others could concentrate on textures, some delicate and light, others deep and heavy; and even others creating lines or curlicues; with the alteration of leading and/or trailing edges of all objects in accordance with the logic of each "instrument"; and all such displays visible, the one over the other or through each other, with the resulting contrapuntal intermix of "orchestral" effects. This effect would be enhanced in a 3D virtual reality system, or if projected on a large-scale display system, for example a movie screen in a theater. Although the VISIC program may be accompanied by music (as suggested above using a Bach Two-Part Invention), it is the contention that there is no logical reason that sound should be introduced or used. You don't need a symphony orchestra when you stand before a painting! Nevertheless it is true that when music is imagined parts of the visual cortex also respond, suggesting that there may be an intimate connection between music and our visual sensations.[25] Music as sound track seems important for movies; visual ideas are enhanced when accompanied by bursts of music. It may even be assumed that, contrariwise, pure, unaccompanied VISIC would give rise to sensations in the aural cortex of the brain. If VISIC is creative, and imaginative violations or reinforcements of brain-based expectations are employed, there is no reason to

demand sound as an accompaniment. A professor of physics in the seventeenth century suggested that a visual display of colors ought to provide a deaf person with the same enjoyment hearing people receive from "the harmonious consonance of musical tones." [26] This is the challenge for a VISIC composer: to create something rich enough to be self supporting; something interesting and all consuming. Then if people become conditioned and well accustomed to VISIC styles, a viable and self-sustaining medium will provide us with a new silent beauty, unique unto itself. The brain ought to be able to be taught to respond to patterns of VISIC based on exposure. The use of arbitrary shapes and the choice of a limited repertory of manipulation in a visual video space permits the formulation of computer program that is a true color organ. Transcribed notation allows a person to "compose" pieces of VISIC, visual color music, and to play them back with virtuosity, analogous to tonal musical. Skill in production and creativity in composition is therefore available for the rendition of VISIC. The complexity of the scoring is greater than that of a piano score, but not any more demanding than that of an organ. The human perceptions of visual objects provide the bulk of our intelligence, and most of the furniture in the house of our consciousness. If, as Susanne Langer suggests, the expression of human consciousness in a single metaphorical image is what constitutes art, [27] the proposed VISIC program creates a new medium for the production of art. On first glance VISIC may appear to be just another plaything for creating spectacular television displays--we see enough of these every day. While we are not able to deal with the aesthetic problems of color music because the media has not yet reached the level of expertise required, it seems inevitable to me that we will some day, if not with VISIC, then with some future equivalent. Perhaps we will be able to achieve a higher exploration of pure moving color forms with VISIC. Certainly it seems to offer an astonishing range of interesting, beautiful and memorable purely visual experiences. As Gordon Graham suggests for music, it seems to me that VISIC could provide the sort of occasion for us to delight not just in the content of experience, but in the beautiful fact of the experience itself. [28] Analogous to music but made for the eye, VISIC is realizable on the proposed VISIC program because it creates a visual flow and object manipulation in color and form. Music hath charms to soothe the savage breast; VISIC may charm the eye of our naive consciousness. VISIC will become a meaningful art form with wonderful aesthetic import when it falls into the hands of a creative composer. It is impossible to know where VISIC will lead. But the conclusion is clear that it can refine how we view all objects in reality;

how we value the objects cast on the human eye; how our consciousness can be articulated for valuable future pleasures and the enrichment of human nature.

* A short version of this concept was published as "VISIC: A Proposal for a True Color Music" in *Leonardo*, Vol. 32, No. 3, 1999, p. 177; Robert Emmett Mueller lives at 30 Homestead Lane, Roosevelt, New Jersey, 08555 USA, phone (609) 448-2605

References

1 - A complete summary of the history of "seeing music" is given by Bulat M. Galejev, "The Fire of Prometheus," *Leonardo*, Vol. 21, No. 4, 1988, pp. 383-396. As Galejev indicates in the appendix to his paper, color musical ideas go back to Pythagorus who mathematized the physical laws of the musical scale and other natural phenomena; and Isaac Newton, under the spell of Johannes Kepler who was taken with Prometheus' music of the spheres, equated the seven tones of the then music scale with the seven colors of the spectrum (Galejev, pp. 392).

2 - More recent inventions and color music systems are described by Lynn Pocock-Williams, "Toward the Automatic Generation of Visual Music," *Leonardo*, Vol. 25, No. 1, pp. 29-36, 1992. This paper is a comprehensive summary of many previous attempts at making color music, including Alexander Scriabin's 1911 *Prometheus* and Thomas Wilfred's 1922 *Clavilux*. See also the early seminal book by Adrian B. Klein, *Color Music: The Art of Light*, London, 1926 and Klein, *Colored Light, an Art Medium*, 3rd. ed., 1937.

3 - See Vassily Kandinski's remarks in *On The Spiritual in Art*, New York, 1946, p. 12. My own attempts at a static "visual music" are described in Robert Emmett Mueller, "Schemas: The Evolution of a Minimal Visual Art Form," *Leonardo*, Vol. 24, No. 3, pp. 273-280; and more recently in a *Leonardo* abstract, "Experiment in Art," Vol. 28, No. 1, 1996.

4 - See Arthur Knight, *The Liveliest Art*, New York, Mentor, 1957, pp. 99-104 for a good summary of non-objective and other experimental abstract film.

5 - See J. Whitney, Sr., *Digital Harmony: On the Complementary of Music & Visual Art*, Peterboro, NH, Byte Books, 1980 and Tom DeWitt, "Visual Music: Searching for an Aesthetic," *Leonardo*, Vol. 20, No. 2, pp. 115-122, 1987. See also the summary article by Henry R., Clauser, "Towards a Dynamic, Generative Computer Art," *Leonardo*, Vol. 21, No. 2, pp. 115-122, 1988; and the Special issue *Visual Art, Sound, Music & Technology of Leonardo*, Vol. 20, No. 2, 1987.

6 - Laszlo Moholy-Nagy, *Painting, Photography, Film*, Lund Humphries, London, 1969.

7 - Rudolf Arnheim, *Visual Thinking*, Berkeley, University of California Press, makes this point on p. 218-219, 1969. See also Vibeke Sorensen, "Synaesthetic Media," *Music Forum*, pp. 6-7, January 1985.

8 - Leo Treitler, "History & Ontology of the Musical Work," *Journal of Aesthetics and Art Criticism*, Vol. 51, No. 3, pp. 482-497, Summer 1993.

9 - See J. J. Fux, *Steps to Parnassus*, New York, W.W. Morton, 1943.

10 - Leonard B. Meyer, *Emotion and Meaning in Music*, Chicago, University of Chicago Press, 1956; see also Rudolf Arnheim, *Art and Visual Perception*, Berkeley, University of California Press, 1954, 1974.

11 - Mueller, "Schema," *op. cit.*

12 - Robert E. Mueller, *The Science of Art: The Cybernetics of Creative Communication*, New York, John Day, 1967.

13 - Stampe, Roehl & Egan, *Virtual Reality Creations*, Waite Groupe Press, 1994.

14 - Various ideas were considered when formulating the initial VISIC program, and choices had to be made. Other arrangements or types of keyboards are also possible, for example dual keyboards, or foot pedals, etc. The version of VISIC proposed here will evolve as experience and usage is

obtained. Compositional theories and studies of harmonic possibilities must await experience with actual VISIC programs.

15 - Erik T. Mueller wrote a brief VISIC program in Think C, using random MIDI or sequenced events and ASCII outputs; he made several brief VISIC studies to prove its viability.

16 - Rudolf Arnheim in *Film as Art*, Berkeley, University of California Press, 1966, emphasizes how critical motion was in the creation of the new film medium.

17 - Although the conventional keyboard of a computer could be programmed for a video-game equivalent of VISIC (which idea is hereby copyrighted), a typewriter-like keyboard does not permit the simultaneous entries.

18 - Rudolf Arnheim, *Art and Visual Perception*, op. cit., the chapter on color pp. 330-371.

19 - Rudolf Arnheim, "Progress in Color Composition," *Leonardo*, Vol. 20, No. 2, pp. 165-168, 1987. See also Laszlo Moholy-Nagy, op. cit., on color composition.

20 - As an art student I poured over Arthur Pope, *The Painters Terms*, 3 vols., Cambridge, Harvard University Press, 1929 that inspired many of my abstract ideas. A more contemporary artist's textbook is Robin Gillam Scott, *Design Fundamentals*, New York, McGraw-Hill, 1951.

21 - The importance of squares is emphasized in Jose C. Sanchez-Mayendia & Carmen Alzola Domingo, "Perceptual Analysis of a Two-Dimensional Image Generated within a Square," *Leonardo*, Vol. 25, No. 2, pp. 205-210, 1992. Also see Barbara E. Savedoff, "Looking at Art Through Photographs," *Journal of Aesthetics and Art Criticism*, Vol. 51, No. 3, pp. 455-462, Summer 1993; Peter Kivy, *The Fine Art of Repetition: Essays in the Philosophy of Music*, Cambridge University Press, 1993.

22 - Rhonda Roland Shearer, "Chaos Theory & Fractile Geometry: Their Potential Impact on the Future of Art," *Leonardo*, Vol. 25, No. 2, pp. 143-152, 1992.

23 - MIDI interface conventions considered are standard state of the art.

24 - Celso Wilmer in "Color-Encoded Musical Scores: What Visual Communication can do for Music Reading," *Leonardo*, Vol. 28, No. 2, pp. 129-136, 1995 suggests a way of "simplifying" the learning and reading of musical scores. His "Raindrop and Rainbow" notation systems are "based on a Cartesian representation of sound duration and color-coded representation of pitch," essentially the obverse of my idea for color musical representation.

25 - Sandra Blakeslee, "The Mystery of Music: How it Works in the Brain," *New York Times*, May 16, 1995, p. C10.

26 - Galejev, *op. cit.*, Appendix, p. 392.

27 - Susanne K. Langer, *Problems of Art*, New York, Scribner's Sons, 1957, p. 53.

28 - Gordon Graham, "The Value of Music," *The Journal of Aesthetics and Art Criticism*, Vol. 53, No. 2, Spring 1995, p. 152.

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