MOZART MINUET PROJECT PROPOSAL- September 4,1986

TO: Gwen Bell, President
Kurt Levitan, Exhibit Technician

CC: Oliver Strimpel, Curator
Bonnie Turrentine, Education Director
Greg Schroeder, Visitor & Operations Coordinator

OBJECTIVE: Creation of a program based on the Musical Dice Game.

PURPOSE:

1. Replacement of the existing program, currently using Microsoft Pascal, because:
   a. There is no existing source code in our hands to make modifications;
   b. The hardware is cumbersome and unsophisticated musically and graphically for the demands of the program;
   c. The hardware and software, as a unit, is unfit to use as a proper hands-on exhibit in the gallery.

2. Necessity of a proper environment for the display and use of the Commodore Amiga, using:
   a. The sophisticated sound capabilities of the Amiga;
   b. The visually-striking graphics package.

3. Fill in the deficiency in the exhibit halls of visitor-interactive exhibits involving musical composition, especially those involving the use of computers.

BACKGROUND:

This Musical Dice Game is said to have originated with Mozart, though the earliest manuscripts existing date after his death. The reputation that Mozart had as a gamester and as a lover of mathematics, as well as his well-documented musical prowess, contributes to this attribution.

The Game involves a set of 176 measures arranged "at random" in a matrix 11 by 16. The gamester would roll a set of dice to determine the proper measure. Sixteen rolls would generate 16 measures, which, when composed together, would form a unique minuet. In theory, 11©16 (4.594E+16) different minuets could be formed, but allowing for some measures repeated and duplicated, the actual number is around 4 quadrillion--give or take a billion.

OUTLINE:

The project, in which Simon Rakov and I are collaborating, is as follows:

- The measures are translated into code and stored in a 176-dimensioned array. The measures are selected from a chart duplicating the historical 11X16 array. Measures are appended to a data file, then read into the sound queues using a parser. The program will generate unique minuets or may repeat the previously composed minuet. Simon and I have a working version of the Musical Dice Game that may be presented at your convenience.

FUTURE DEVELOPMENTS:

In addition, we would like to add:

1. A graphic representation of the minuet being played, complete with scrolling staff.
2. An option allowing the user to circumvent the random generation of the measures and compose the minuet at will.
3. An opening title screen describing the exhibit with a generated minuet as background music.
4. Explanation of the minuet's history and mathematical principles behind the musical selection.

PRESENT MODIFICATIIONS NEEDED:

In addition to the future modifications, we are working on current bugs. The parser is slow in compressing the information into the sound queues; we have timed it at 45 seconds. We wish to make it quicker by employing some assembly calls. Also, we would like to modify the sound wave in order to create a "harpsichord" effect. The sound, at present, is choppy at the end of notes and unnaturally slow in melody-playing.

REQUESTS FOR MATERIALS:

There is a book in the Museum Store called "Programming the Commodore Amiga" ($26.95 list price, $21.45 discount price). We have examined it to be suitable in assisting us in creating the graphic portion of the program, as well as an aid to speeding up the program. We would like to obtain this; please advise on compensation.

PROJECT DUE DATE:

I had budgeted by Labor Day to complete the first stage of the program. We were only 2 days overdue (September 3) on this schedule. I am persuaded by Brooke's Formula on Software Project Estimates to predict completion by Thanksgiving, but the progress has been encouraging and positive; we could have it done by Halloween. However, allowing for the inevitable hidden bugs,.I am assessing November 12th as the due date.

Submitted by

Thomas F. Restivo

Thomas F. Restivo

;-*- Mode: Text -*-

Ask MK for semi-technical input

Contacts - who to call?

Objectives
Dynamic, interactive, artistic, raises curiosity, thought provoking, fun, good for groups and individuals, young and old, extensible, evolutionary, easy to grok, accessable ...

Scientific interest
Computer science, biology, anthropology, math, psychology, AI, animal psychology, behaviorists ...

Unique
Not done before, hard to simulate in software, general public can make discoveries

Technologically feasible
Off-shelf components, fault tolerant, not all fail at once, scales well, Thinking, out of software

Possibly interested people (alphabetically)
software Carl Feynman, ~~Danny Hillis~~, Brewster Kahle, Steve Omohundro, Steve Strassmann, Steve Wolfram

AK Terrapin

Microworlds (Lego + Logo) Subcontract

Organism
Objectives - Modular, easy to manufacture, easy to maintain, reliable, cheap, simple, possibly sold in gift shop for home, suitable for different terrains,
Cost - $50 - 100
Quantity - ~100
CPU - 68000 or other common micro
Memory - average, say 64K words of ram
Sensors - collision (switches, rubber contact strip), light (photodiodes) sound (microphones), ultrasound (sonar), electric contacts, temperature ...
Actuators - Mechanical simplicity, reliablity very important. Drive wheels, fork-lift, LED's, turtle pen, audible feeper...
Communication - Audible touch-tone, LED's, ultrasound, radio, serial port
Mechanical - terrain: hard land, sand, shallow water,
- robust, cute, personality touches (fur, names, fins, etc)

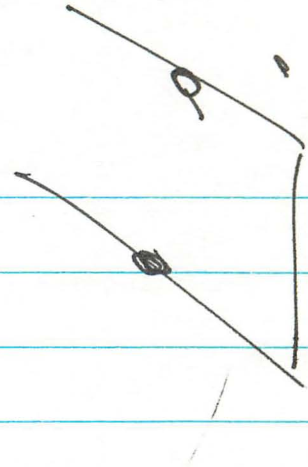
Environment
Modular, evolutionary, interactive, accessible, interesting, easy for lots of kids to crowd around perimeter (footbridge, non-square perimeter), easy to clean, safe for very small children, (small groups of escorted toddlers, maybe)
Special lighting effects, fog machine, adaptable to different themes.

Control
Central computer - controlling environment, relaying info among organisms monitor state of all organisms
User stations - reprogram, monitor individual organisms, play games with other users

Activities
Objects - Nerf balls, blocks, beeping blocks, water balloons, ping pong balls, velcro blocks & balls, dead (sleeping) organisms, wind-up toys, buttons & levers to push (for organisms and people), pennies, marbles
Environment - Escalators, ramps, mazes, storage bins, rotaries, see-saws, conveyor belts, tunnels, elevators, bridges...
- communication with host computers, location beacons (lighthouses)
Recharge stations - stationary, mobile, not always on, one per team ...
Cooperation - Stacking, sorting, spelling out words, retrieving, dancing, drawing pictures, solving a problem, repairing the environment, assisting sleeping organisms, following humans, extinguishing bunsen burners, shepherding bunnies into corral,
Competition - hoarding, nudge warfare, strategic games, picking up pennies,

Development activities-
Mechanical design
Power subsystem (organism)
Recharge subsystem (environment)
Motor/actuator control subsystem
Sensor subsystem
Communication subsystem
Location-finding subsystem
Operating system (organism)
Programming environment (developers)

Programming environment (users)
Debug and diagnostic facilities (electronic)
Repair facilities (mechanical)
Build prototype
Design initial environment
Build initial environment
Design exhibit activities, documentation
Publish exhibit documentation, make signs
Production (build modules)
Production (assembly)
Train maintenance people

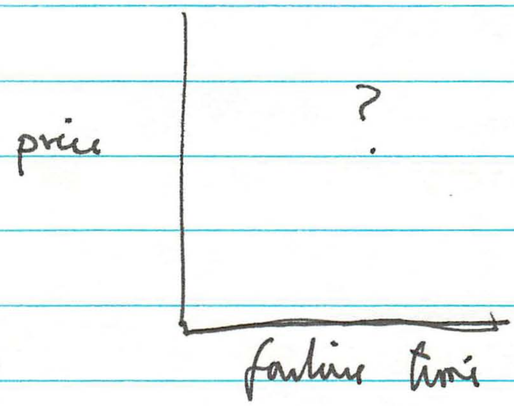


Mechanical Problems – Motion

1. Terrapins – failed

Magnetic Levitation

Motors fail



[200 : 1600 hours motors

10 hours between feeding

Bump-sensors : microswitches OK

No oiling ~~see~~ to be necessary.

Recharge ; duration of recharge
MTBF for
low friction at room temp
Air tables

Brownian or mechanical

Undercurrent electromagnets

1. Investigate electric motors
2. Alternatives

Communication : Acoustic

: Touch-tone for Low G/W

& 1 chip for all aspects

Localising source

<u>Simulation</u>

Insect behaviour:

Incorporate sufficient features

<u>Robotics</u> Special interest gp in BCS

Trip Hawkins for shell design
Steve Ciarcia for prototype model
Fibronics or optical communication

Robot Colony

free rights:

1. Design of ants : mech & electrical & electronic hardware

   Free from Thinking machines

2. ~~ANT~~ Software : downloading to ants
   Ant - ant communication
   Cage - ant

   Prob free from Thinking machines

$5k 3. Fabrication of prototype ant ; moulding? Wire-wrap?

$100 n (20k for 200 ants)

~~$50k~~ 4. Mass-production of ants — Battery holder, motor, moulding, pcb, light pipes, photodiodes, bump sensors

$5k 5. External pc. Program development Cage Control System

if computer stuff donated — eg Apollo ; have several stations

$5k 6. Cage + recharger + software Cabling

$10k 7. Build surround, some kind of railing

$5k 8. Cage floor

9. Signs

Stan Kugell:

David Schrier 'Mini Robot' (friend of Stan Kugell)

Assembling pump

Tactile Exhibit

Call president of Buckminster
motors, encoders, amplifiers, control cards,
& other necessaries

Hardware:

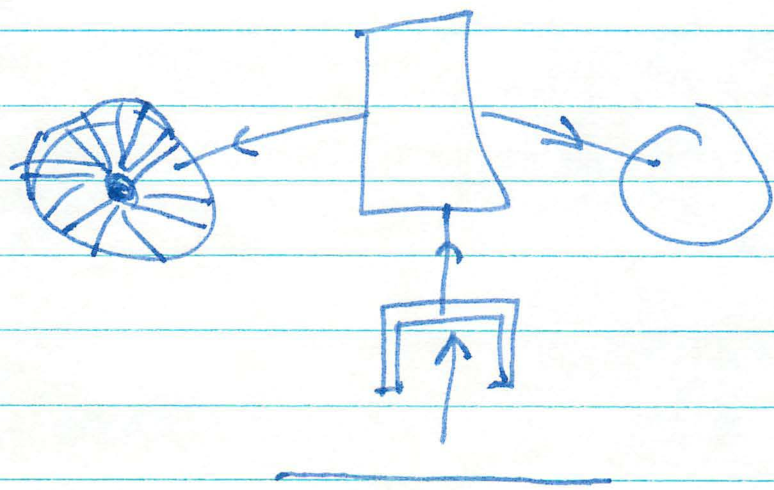
regular pc

motion control : Buckminster Corporation :, Cambridge
equipment : motors & encoders resell 864 2456
controller : make themselves

Can call Stan to get more info

Software : on Atari cartridge

Implementer



Amplifiers Crown : expensive
↓ donation?

"SEMI-REAL"

OK

NO. WHO WHAT

82-74 Twhitted/Bell Chess piece. Fog is modelled by decreasing color saturation with distance.

83-05 Hall/Cornell ~~[illegible]~~ An imaginary sculpture gallery. Note the infinity effect of the mirrored
walls at the rear. Where is the camera?

83-04 Lorig/RPI Solid modelling with transparency and refraction. The martini glass is a
solid of revolution. The olive and the dice are super elipsoids.

83-56 Collery/CSI Solids of revolution illuminated by multiple light sources. Effective use of
blurring to simulate reflection and depth-of-field

80-59 III Intriguing effects produced by controlling illumination. Note that all 3 shapes
have a rear light source, ~~[illegible]~~ but ~~[illegible]~~ cone is also ~~[illegible]~~ lit from the right,
80-18 Marshall/OSU ~~while the cube is lit from the left.~~ light radiating from the sphere is also modelled.

A forest of different trees, each with hundreds of individually-modelled leaves
80-83 III No shadows are modelled.

A gallery of levitated objects. Carefully-balanced modelling of illumination and shadow.
79-20 III Effective suggestion of refraction done without recourse to ray-tracing.
The water is a periodic function, the clouds are clusters of translucent ellipsoids

"SHOWING DATA"

NO.	WHO	WHAT
82-55	Dutton/HU	Colorscale classification reinforces similarities and differences between states in a 3-D portrayal of population estimates
80-25	McCleary/NOSC	Careful in associating color with ocean depth highlights continental shelves and the Atlantic mid-ocean ~~rift~~ range
80-44	Cantwell/Dunn	Effective use of limited data on acid rain highlights the changes in this controversial environmental threat.
79-51	Meyers/LLL	A graphic rendition of ozone concentrations around the world. The distinct striations reveal variations associated with both climate and civilization.
84-A01	Aydin	A process control diagram of a steam turbine electrical generator. Such diagrams can be continually updated to inform plant operations.
83-18	Hodson LANL	Schematic cross-section of a nuclear power generator. Functions are coded by color while basic spatial relationships structure the graphic

Design and Visualization

NO	WHO	WHAT
83-14	Ford	Design for a piston and crankshaft with realistic shading and color. Any portion of the engine can be retrieved for graphic display.
79-46	Max/LLL	Two cycles of atoms in a coil of DNA are composed using shaded spheres, color-coded by element.
80-02	Max/LLL	A Fantastic form, actually atoms of the Tomato Bushy Stunt Virus. Atoms are glossy in this rendering, but can be matte or translucent.
79-42	Shantz/CALTEC	A model of the human brain...
83-12	Aydin	Cutaway view of a valve assembly. Sectioning and color can be controlled to highlight form and function.
83-11	Aydin	A pressure valve assembly with sub-assemblies color-coded. Light is modelled as originating at the viewpoint.
84 C01	Cadcentre?	Preview of a design for an oriental rug. Many designs can be visualized before generating the numerical instructions for the automated loom.
80-45	Cantwell/HP	The layers of skin, structure and machinery in a complex system are easily distinguished in this cutaway view of the space shuttle.

RAY-TRACING

83-18 DUP of RPI gallery

82-08 conley/OSU Ray-tracing, fully exploited, models ~~not only~~ both the refractions of the transparent solids, ~~but~~ and their further refraction by the lens on the right.

83-21 HO simple shapes & made into a complex image by tracing reflections, refractions, shadows and opacity. One overhead light source.

82-76 Whitted/Bell A simple still life with a single light source, rendered believably by projecting shadows on plane and curved surfaces.

FLIGHT/WAR SIM

83-72 STIPE/ATS Atmospheric perspective and smooth shading add considerable realism to the schematic tanks and ~~simple~~ stark environment.

79-62
~~83-18~~ Rowley/Marconi Painterly effects result from painting simple shapes with pastel colors ~~and~~ in a variety of texture patterns. Note modelling of reflection in calm water.

83-74 cohen/ATS Dulles Int. Airport, complete with SST's. Considerable detail is represented for a simulation frame.

82-68 LUCAS/Paramount Fire envelopes a dead planet in the middle of the Star Trek II Genesis seq. The planet ~~surface~~ is a fractal surface, the flames a field of cascating particles.

84-S01 Sagitec? California-style landscape rendered in France. Earth, sky and structures require different modelling systems.

SIMULATION

OK

NO.	WHO	WHAT
82-84	PICOMED	A cryoalis is transformed to a butterfly. Key-framed painted.
82-69	Lucasfilm/Paramount.	Final stage of metamorphosis is to a living planet.
82-29	NYIT	3D model of castle, texture-mapped water; simulated moonlight from rear with ambient component.
83-62	Genegraphics	2-D painting; subtle use of color in the blue range.
79-14	NYIT	Conventional 2-D cell animation under computer control.
80-31	RPI	Transparent and texture-mapped spheres. Models refraction and reflection.
80-34	RPI	~~Texture mapped~~ color photo mapped on a deformed cylinder of revolution
79-13	NYIT	True 3-D entertainment animation requires much time and memory.
83-06	UCB	Superquadratic shapes with periodic surface patterns, different amounts of glossiness.
83-03	Genigraphics	High pixel resolution and many bits of color are required for this crisp construction
82-19	III/Disney	Light sail from Tron. High-resolution animation sequence
82-18	Kawaguchi	Both physical and optical properties are simulated in a splash.
82-13	Sogitec ?.	Illustrates the elements involved in digital flight simulation systems — ?
82-05	OSU	Fully-articulated human skeleton is programmed to walk through environments
JPL-01	JPL?	The view from Saturn
80-09	LLL	Simulation of impact of a weapons nose-cone (R) compared to actual behavior (L).
82-12	JPL	Saturn Rising over Phobos or Deimos.
80-04	LLL	Results of stressing an aluminum casting (R) and its finite-element simulation. ~~Collis~~ Simulation of a high-speed ~~collision~~ impact of an aluminum ~~bar~~ ~~cone~~ casting onto a hard surface

L – lab experiment
R – computer simulation

10655733

Shift Multer

<1>

THE ROAD TO POINT REYES

This image, one of the most complex to be synthesized by computer, was made by rendering its constituent parts separately and then combining them together.

<>

Lucasfilm Ltd

<2>

The Road To Point Reyes - Detail

The following slides show the separate elements that went into this portion of the image.

<>

Lucasfilm Ltd

<3>

Forground Grass

Simulation of grass by the road verge.

<>

Lucasfilm Ltd

<4>

Fence

The posts' surface are mapped with wood texture taken from a photograph of wood.

<>

Lucasfilm Ltd

<5>

Background Grass

Where fence and grass coincide, the computer will render the fence.

<>

Lucasfilm Ltd

<6>

Foreground

The composite of foreground grass, fence and background grass.

<>

Lucasfilm Ltd

<7>

Shadow

The position of the fence's shadow from a is worked out and painted in by hand.

<>

Lucasfilm Ltd

<8>

Hill

A hill is modelled using part of the surface of a sphere covered with a grassy texture.

<>

Lucasfilm Ltd

<9>

Plant

A forsythia plant is modelled using particle systems - a technique in which fuzzy objects are represented by the trails of moving particles which fork randomly.

<>

Lucasfilm Ltd

<10>

Road

The road is rendered by a flat surface covered by "road texture" taken from a

6. If you want to check. A.

photograph of the parking lot at Lucasfilm Ltd.
<>
Lucasfilm Ltd
<11>
Post Reflection
To simulate a glossy road surface, reflections in the road must be included. This element shows the part of the fence that appears in the road.
<>
Lucasfilm Ltd
<12>
Glossy Road
A composite of the matte road and the reflected fence post together with some plant reflection.
<>
Lucasfilm Ltd
<13>
Hillside
A composite of the hill plants and road with reflections.
<>
Lucasfilm Ltd
<14>
Background
Blue sky with a rainbow.
<>
Lucasfilm Ltd
<15>
Composite
This is built up from the foreground, shadow, hillside and background. It is part of the final image, Road to Point Reyes, displayed opposite the large gallery window to your right.
<>
Lucasfilm Ltd
<16>

USING COMPUTER GRAPHICS TO CONVEY INFORMATION
<>

<17>

Schematic cross section of a pressurized water reactor, a type of nuclear power reactor.
<>

<18>

A process control diagram of a the state of a steam turbine generator. Such a diagram would be continually updated to keep plant operators informed.
<>
Aydin Controls
<19>

World map colored according to ozone concentration. Such renditions are useful in disentangling the effects of

climate and man's activities.
<>

<20>

Maps colored according to the acidity of rainfall show the changes between 1955 and 1975.
<>

<21>

A map of the Atlantic Ocean colored according to ocean depth clearly reveals the continental shelves and the Mid-Atlantic Ridge.
<>

<22>

Use of colors and vertical height allows quick interpretation of population estimates for the year 1990.
<>

<23>

COMPUTER GRAPHIC IMAGES FOR DESIGN AND VISUALIZATION
<>

<24>

Design for a piston and crankshaft with realistic shading and color. Any portion of a computer model can be retreived for graphic display.
<>

<25>

Computer model of part of a DNA molecule, showing some 7000 atoms (171 base pairs). Each sphere represents an atom as follows:
dark blue - carbon
ight blue - nitrogen
red - oxygen
yellow - phosphorous
hydrogen - omitted
<>

<26>

Computer model of the tomato bushy stunt virus. The large spheres represent chains of amino acids; the small yellow spheres represent single amino acids which link the whole virus togethe
<>

<27>

Computer representation of the human brain.
<>

<28>

Computer rendered image of a last for a lady's shoe. A three-dimensional computer model is created by the designer. The data is then passed directly to the machines that manufacture the last.
<>
Clarks Ltd, UK
<29>

Computer rendering of a Lady's Court style shoe. Designers can use such images to convey their ideas before commiting to manufacture.
<>
Clarks Ltd, UK
<30>

Diagram showing shapes of leather pieces required to manufacture the lady's shoe seen in the previous slide. The pieces are cut out by a high speed jet of water under computer control.
<>
Clarks Ltd, UK
<31>

Pressure valve assembly with color coding for subassemblies.
<>

<32>

Cutaway view of the valve assembly. Cutaways, sectioning, coloring and even transparency can be controlled to help visualization.
<>

<33>

Rug design on a computer screen. Many color schemes can be viewed before proceeding with manufacture.
<>
CADCentre, UK
<34>

Model of the space shuttle, colored according to anticipated surface temperature upon reentry to the atmosphere.
<>

<35>

Simulation of a high speed impact of a nose-cone.
left : computer model
right : actual experiment
<>

<36>

Simulation of the collision of an aluminum bar onto a hard surface.
left : real experiment
right : computer model
<>

<37>

Simulated view from a Voyager space probe of Saturn rising above one of its moons, Mimas.
<>

<38>

Simulation of Voyager 2 fly-by of Saturn's rings.
<>
James Blinn, JPL
<39>

ARCHITECTURAL VISUALIZATION
<>

<40>

Simulated view of proposed development. Landscape features can be added in to aid visualization.
<>

<41>

Many light sources are modeled here to simulate the nighttime appearance of a building.
<>

<42>

Simulation of a large urban development.
<>

<43>

Simulation of a room interior with realistic lighting and furnishing.
<>

<44>

IMAGES GENERATED ON COMPUTER PAINT SYSTEMS

Shapes and colors are input with a device such as graphics tablet.
<>

<45>

Paint systems allow subtle use of color. Generated using a Genigraphics 100C paint system.
<>

<46>

Generated using a Genigraphics 100C paint system.
<>

<47>
"Paris Facade"
Created using Digital Effects' Video Palette Paint System.
<>

<48>
"Bouquet Fleche"
The outlines were drawn by a computer-driven plotter; the coloring is by hand.
<>

<49>

MISCELLANEOUS EXAMPLES OF COMPUTER IMAGE SYNTHESIS
<>

<50>

Use of the ray-tracing technique to simulate reflection and refraction.
<>

<51>

Use of texture mapping to simulate surface patterns.
<>

<52>

By simulating the reflection properties of real substances, different materials can be simulated.
<>

<53>

A simple still life with a single light source, rendered by projecting shadows onto flat and curved surfaces.

<54>
"Concord's Inaugural Landing"
Dulles airport's control tower with Air France's and British Airways' Concords in the foreground.
<>

<55>

A village in the Vosges Mountains, France is simulated by rendering topographic data for the region.
<>
Sabine Coquillart and Michel Gangnet
<56>

Fog is modeled by decreasing the saturation of the colors with distance.
<>

<57>

Modelling of a solid with transparency and reflections. The Martini glass was made by sweeping the glass's outline about a vertical axis, making a solid of revolution. The olive and dice
are distorted versions of ellipsoids called super-ellipsoids.
<>

<58>

The vases are solids of revolution illuminated by multiple light sources. Deliberate blurring simulates reflection and depth of field.
<>

<59>

Intriguing effects can be produced by unnatural lighting. Light appears to come from behind as well as from the sphere.
<>

<60>

A surreal effect is induced by levitating objects and balancing illumination from the window with
lighting in the gallery.
<>

<61>

Refraction of light is suggested without actually modeling it with ray-tracing. The water is a periodic function and the clouds are clusters of transparent ellipsoids.
<>

<62>

An experimental use of computer graphics that could enhance teleconferencing. The system creates animated images in response to directions transmitted over ordinary telephone lines.
<>
AT&T Bell Laboratories
<63>

Sophisticated use of color in the blue range created on a paint system.
<>

<64>

Frame from an animation generated by

computer.
<>

<65>

Frame from computer generated animation using three-dimensional models. Sequences animated this way require large amounts of computer time.
<>

<66>

High spatial and color resolution are required for crisp images such as this.
<>

<67>
SOLAR SAILOR OVER THE SEA OF SIMULATION
This frame from the film "Tron" was produced at a resolution of 6000 x 5000 pixels.
<>

```
@  This file describes the demo as a set of frames.  The program when it
@  starts up reads in this file into an array and then uses it to run the
@  demonstration.  Merely editing this file will permit the demo to be
@  re-written as long as certain things don't change.
@
@  The lines of this file are restricted according to the following rules.
@  The first character of a line specifies what kind of line it is.
@
@-----------------------------------------------------------------------------
@  First, all lines that begin with an "at-sign" (@) are ignored by
@  the program when reading this file.  These are comments and can be used
@  to explain how the demo is set up.  This places the restriction that
@  no demonstration screen frame can have an at-sign on the left margin.
@  This should not prove difficult.
@
@-----------------------------------------------------------------------------
@  Secondly, certain system parameters are set by lines beginning with
@  an equal sign (=).  The line indicates which parameter is set by the
@  single letter following the equal sign.  This means that demonstration
@  screen frames cannot begin with equal signs.  This should not be a problem
@
@  The FIRST system parameter set by this file is only used to tell the
@  program how many frames there are overall.  If this number is too big,
@  that's no problem, the program saves too much space.  If the number is
@  too small, then the program will not read in some of the frames from
@  this text file.
@                                                   6
@ We want room for a lot of frames       15, 14, 5, 4, 10, 2, 9, 1.
=s 20
@
@ specify the colors of the touch sensor display, from min to max
@       according to the IBM manual the colors are:
@                0  = black     white yellow green blue  red brown      black
@                1  = blue
@                2  = green
@                3  = cyan
@                4  = red
@                5  = magenta
@                6  = brown
@                7  = white
@                8  = gray
@                9  = light blue
@                10 = light green
@                11 = light cyan
@                12 = light red
@                13 = light magenta
@                14 = yellow
@                15 = hi-white
@original program uses:  8, 1, 9, 2, 3, 4, 5, 6, 14, 15
=c 6, 4, 9, 8, 1, 9, 14, 12, 7, 15
@
@ specify the character to use as the OUTLINE character of the edge display
@ the 176 was found by accident to do blinking forground
=o 176
@
@ specify the THRESHOLD sensitivity (normally zero or 1) and
```

6, 7, 14, 10, 2, 1, 5, 4, 0

c= 11, 1, 9, 2, 10, 6, 4, 5, 14 + "sensor" to next line and change "darker" to "lighter"

```
@ the number of regions of sensitivity permitted  (ie, DIV)
=d 0, 8
@
@ specify the ATTRIBUTES display control (numbers or colors)
@ (1=numbers, 0=colors)
=a 0
@
@
@ specify whether we want fake data or the real thing
@ non-zero means fake data
=f 0
@
@--------------------------------------------------------------------------
@  Thirdly, all frames begin with a line which begins with a sharp sign
@  (#).  All lines after that up to but not including the next sharp sign
@  are interpreted as part of the frame or slide to be displayed (excepting
@  the lines beginning with @, # or =).
@
@  The line with the sharp sign contains numbers for use by the
@  program to tell it what to do.  These numbers are called
@
@     ACTION -- what action to do while displaying frame
@     WHEN   -- when to move to the next frame
@     NEXT   -- which frame to go to next
@
@  These are specified on the EQUALS line, separated by spaces, in the
@  order of ACTION  WHEN  and NEXT.   All three are always required.
@
@  If NEXT is ZERO, then this is a default to tell the program to go to
@  the next sequential frame in this text file.  (If it's the last one, it
@  goes back to the beginning.)  The frames are numbered sequentially in
@  the file, starting with frame number one.
@
@  definitions for ACTION:
@
@    0  - do nothing but display on empty screen
@    1  - display sensor data
@    2  - display block outline
@    3  - display object orientation
@
@  definitions for WHEN:
@
@    0   - any touch on the sensor means move on
@    1   - any touch on a corner of the sensor means move on
@    2   - wait ten seconds and then move on
@    3   - wait twenty seconds and then move on
@
@
@ Here comes first frame, it waits for any change in the sensor data.
@ ACTION, WHEN, NEXT
# 0 0 0
                  ROBOT TOUCH SENSOR DEMONSTRATION
```

HELLO! Please press gently on the touch sensor
below to start our demonstration.

```
       |||||
       |||||
       |||||
       |||||       P R E S S
     \\\\ ////
      \\\ ///        T O
       \\ //
        \V/        B E G I N
         V
```

@
@
@ Here comes second frame. It waits for user to touch sensor.
@ ACTION, WHEN, NEXT
# 0 0 0

This is a demonstration of a ROBOT TOUCH SENSOR.

The sensor you see below is actually a collection of very
small sensors organized in 16 rows each with 16 columns.
(That's 256 in all.) If you look closely, you can see the
rows and columns in the sensor surface.

(Press the sensor again to move on in our demonstration.)
@
@
@ Here's third frame, it wants user to press a corner before moving on.
@ ACTION, WHEN, NEXT
# 1 1 0

The color pattern on the right half
of the screen shows what the sensor is
"feeling". Each different small square
of color shows what one of the 256
mini-sensors are registering. A ~~darker~~ lighter
color means that there is more pressure
on that specific mini-sensor.

Notice that if you press hard with your
finger, that the center of the area you
are pressing on is ~~darker~~ lighter than the edges.

(Press one of the CORNERS of the
sensor to move to the next part of
our demonstration.)
@
@
@ Here's fourth frame
@ ACTION, WHEN, NEXT

2 1 0

Pick up the small BLOCK that is sitting near the sensor and press gently with a flat surface of the block on the sensor. You can see that the the edges of the block are easily noticable... The color changes dramatically from a dark color to a light color.

The program is showing the edge of the block by repainting the picture to show where it thinks the edges of the block are located.

Using the wooden egg near the sensor, press steadily ~~down onto the sensor~~

(Press one of the CORNERS of the sensor to move to the next part of our demonstration.)

@
@
@ Here's the fifth frame
@ ACTION, WHEN, NEXT
# 3 1 0

The area ~~on~~ at the lower left of the screen ~~is~~ show~~ing~~s the alignment of ~~the~~ an object ~~you are~~ pressing down on the sensor. To do this ~~That is,~~ the program ~~is analyzing the sensor data and determining~~ takes information from ... the ~~orientation of the block on the~~ sensor.

(Press one of the corners of the sensor to move on in our demonstration.)

@
@
@ Here's the last frame and go back to the beginning
@ ACTION, WHEN, NEXT
# 0 3 1

~~So you can see that with~~ With a simple set of rules ~~the~~ a robot can use a touch sensor to:

a) tell how hard it is grabbing something,

b) tell where the edges of an object ~~is~~ are, and

c) tell ~~how the object~~ which way an object is pointing.

A sense of touch...
~~You can imagine how useful this would be for a robot in a factory situation assembling automobiles.~~

For more on robot touch see the "Dexterous Hands" video program to the right.
~~Thanks for trying this demonstration. Please enjoy~~

THE END

~~yourself at the Computer Museum~~.

TOUCH SENSOR

General Problems:

-Too many places are sensitive to changing screens. The "To Continue" sensor should be located only at the lower right corner of the pad, where the red dot is painted. Currently, touching any edge of the pad will change the program to the next screen.

-Colors don't seem to correspond to touch very well. A light touch makes the squares white almost immediately, while it is very difficult to maintain a square in any other shade.

Specific Problems and Changes:

3rd Screen-

Change sentence to "...A lighter color means that there is more pressure on that specific mini-sensor.

Notice that if you press hard with your finger that the center of the area you are pressing is lighter than the edges."

4th Screen-

"The area at the lower left of the screen shows the alignment of ~~the~~ an object pressing down on the sensor. To do this the program ~~analyzes the sensor data and determines the orientation of the object hitting the sensor.~~" takes information from the sensor and then determines which direction the object is pointed.

this isn't very clear

-make line horizontal on screen (diagonal is confusing), or at least parallel to rows on sensor. When there is only a single point in contact with the pad how can the program draw a line? (Geometrically sound??)

5th Screen-

"Press the ~~marble~~ wooden egg steadily down onto the sensor pad with the amount of pressure you think it would take to ~~crack open~~ crush a real egg. The computer will show how close you were with your guess." tell you when a raw egg would crack."

6th Screen-

"With a simple set of rules a robot can use a touch sensor to:

a) tell how hard it is grabbing something,
b) tell where the edges of an object are, and
c) tell which way ~~the~~ an object is pointing.

A sense of touch is very useful to robots in situations ranging from factory assembly lines to artificial hands.

~~Thanks for trying this demonstration.~~ For more on robot touch see the "Dexterous Hands" video program to the right. ~~Please enjoy your stay at The Computer Museum.~~"

THE END

Touch Sensor

- Too sensitive with colors: a light touch makes the squares turn white almost immediately
- Too many places are sensitive to changing screens. The "To Continue" sensor should be located only at the lower right corner of the pad.

3rd Screen: "... A lighter color means that there is more pressure on that specific mini-sensor.

Notice that if you press hard with your finger, that the center of the area you are pressing is lighter than the edges."

4th Screen: "The area at the lower left of the screen shows the alignment of the object pressing down on the sensor. To do this the program analyzes the sensor data and determines the orientation of the object hitting the sensor."

- make line horizontal on screen (diagonal is confusing), or at least parallel to rows on sensor. When it is only a point in contact how can the program draw a line? Not geometrically sound.

8

Screen 5: Using the marble egg, press down on the sensor pad as much as you think it would take to crack open a real egg. The computer will show you how close you were with your guess.

Screen 6: With a simple set of rules ~~thus~~ a robot ~~will~~ can ~~a~~ use touch ~~sensor~~ to:

a) tell how hard it is grabbing something,
b) tell where the edges of an object are and
c) tell ~~[illegible]~~ which way the object is ~~pointing~~.

~~This~~ A sense of touch is very useful to robots in situations ranging from factory ~~work~~ assembly lines to artificial hands.

Thanks for trying this demonstration. For more on robots touch see the "Dextrous Hands" video nearby. Please enjoy your day at The Computer Museum

NASA — Houston, TX
Media Services

713/483-3111 Main #
713/ " -8693 x (?) media services

> Get Mac version of "Click on button"

~~> give Hyper Dino Stack~~

~~> Futura~~

- Provide:
  - ~~12 picts for Attract~~
  - Artist ✓
  - Computer ✓
  - ✓ Dinosaur. (large size) (get name)
  - Paint pallet,
  - other pics. ⟷ 3 picts (drawn ✓ w/ program)
  - ~~"CONCLUSION"~~
  - Artist at work. ⟵ • A concluding picts (art field, business)

Mac version of "Click Mouse To Begin"

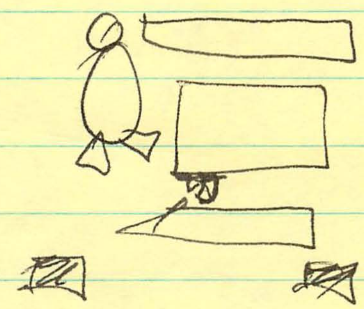
10/23/

Opening Screen.

12 steps → (12 color pics)

Girl Intro.

- provide pict of this screen (Separate)



Finish Dino.

- Dino has to fit

Draw Dino.

- A series of Dino for "Dino Ideas" – 3 Dinos
- Paint pallet

Choice.

- 3 picts to modify. (drawn based on program) (small here, but larger with screens)
- Conclusion

G JACOBS / S NOLAN
88R CLARENDON AVE.
SOMERVILLE, MA 02144

BOSTON, MA 02
PM
25 SEP
1991

Journey
to a
New
Frontier...
Collect Stamps

David Greschler
The Computer Museum
300 Congress St
Boston MA 02210

- attract Screen.
- The screens seem bland.
- ~~Needs to offer choice after first drawing of~~ dino
- ~~A~~ Drawing dino from scratch needs a "give me a start" button that draws a basic beginning

- Take out Printing for now. X
- . "Ikeet you'll slow..." needs to be removed.

- Cursors need to be bigger

Questions.

- Should be left as is that pen needs to be selected
- Not a problem that they can click on button
- I have a little problem with it - it comes off a little chunky.

needs graphics for:

- Attract -
- Choices -
- ~~Overmut~~ -
- Text.
- incomplete Dino

- ~~[illegible]~~ • Color in screens.
- Dinosaur.
- Fonts.
- little girl.

24 September 1991

Dear David,

Enclosed is Dino Draw 1.0a3 in all its glory. I know it works on a IIsi, 13" monitor. Let me know if there are problems with different configurations. To quit the program, keyboard Command-Q at any of the painting windows.

Bugs include: Tools background pattern doesn't always redraw properly
Update is slow in 'add smile to the dino' window

Art done by a graphic artist: sample art drawn in Dino Draw (bird, etc)
a palette (not an oven mitt)
a replacement for the girl
outline of a dinosaur for the attract screen

Sample art & dinosaur need to be drawn so that it looks like "Dino Draw" could have drawn it. E.g. lines should be drawn with pen of 2 pixels wide by 8 pixels high (roughly).

Some questions for you to ask people as you show the program:

- Should the pen already be selected on entering the first drawing module, or is it better to have the explanation of how to select a tool?
- Is it a problem that the user can use any of the tools to click on the buttons?
- Is the thickness of the pen tool acceptable?

Can you tell that I type as I think?

Talk to you some time after 15 October.

Happy drawing!

Gloria

Gloria Jacobs


Dino Draw 1.0a3
102655733

Sim City.

— You need to be led along, just like the alerts, but on a more regular basis.

— It needs an introduction, an explanation. a Screen where you see the entire event, and an explaination of what the different choices are.

Also, icons to see the different maps.

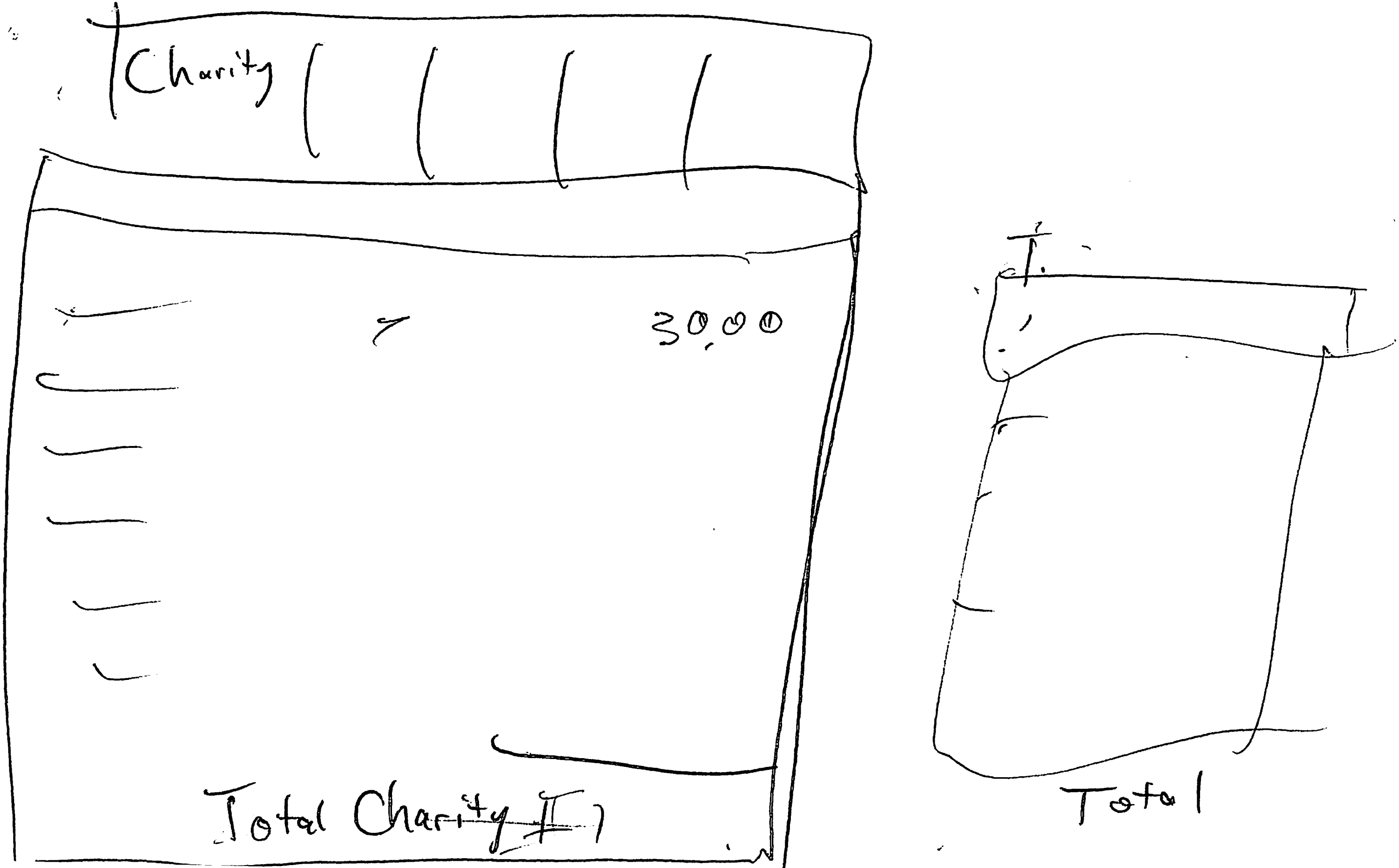
A 5 min-time out. —

A speeded up game —

more problems quickly —

---

maybe disable some of the things you can buy.


Charity
30,00
Total Charity II
Total

(cast Julie Otis)

WHAT IF YOU WON 1M$?
(money falling)

(Ted McSPAM)

Spend choices
if you had the following choices

Charity | House | Car | Travel | Computers

open own business | Savings

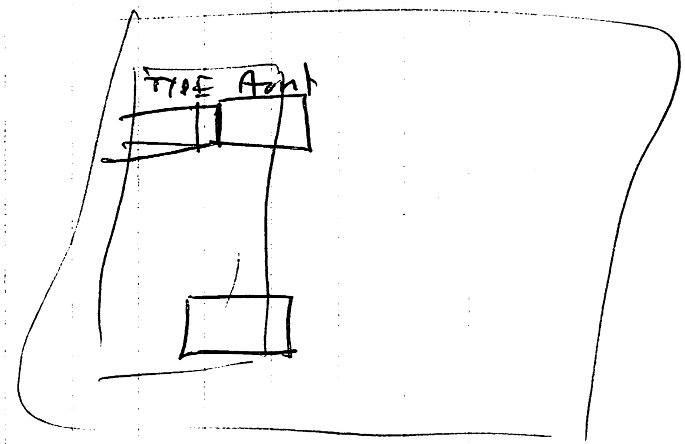
Pay off credit card loans

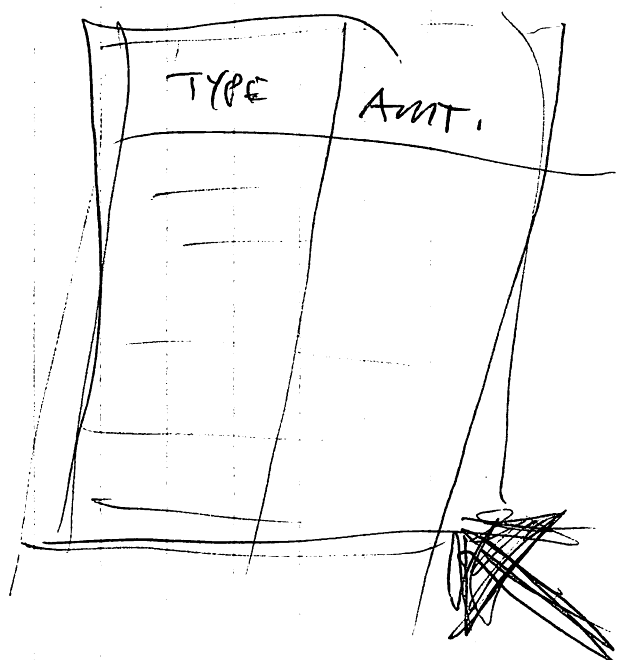
Finance Political activity

Sprea

[Watch Spending]

All element have costs
~~sometimes specic cost~~





→ speadsheet - show 30 lines

Min of all elements - 30 add up to one 1M.

→ A speadsheet of each area.

→ Provisions for cleansing.

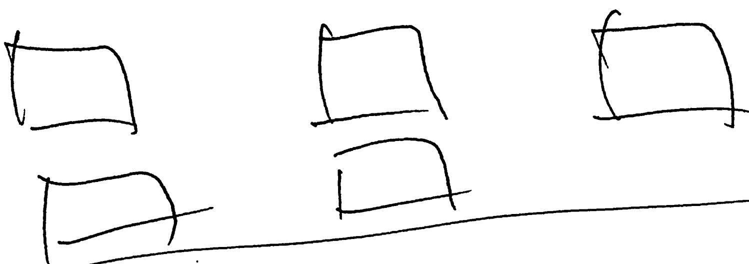
Graphing.

- where you spend your money.
  (choice of charts — which one communicates ~~your~~ this best?)

- Based against other visitors →
  (choice of charts.)

(once they spend 1 million dollars, allow them to make changes)

You've spent your 1 M$ - Do you want to make any changes?

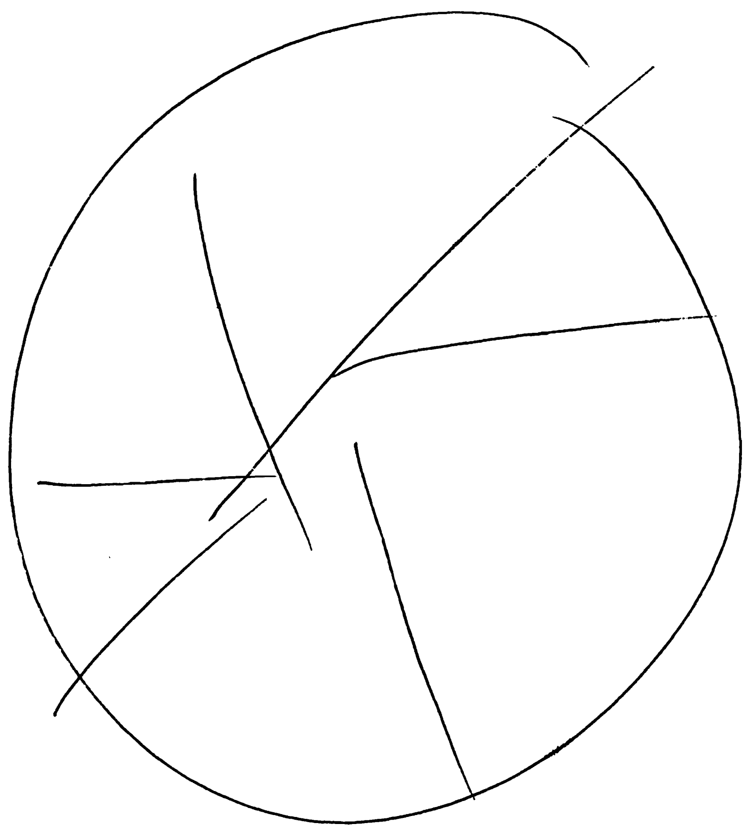
 etc....

(needs something more about spreadsheets + how people use them)

GRAND TOTAL

TYPE	AMT.

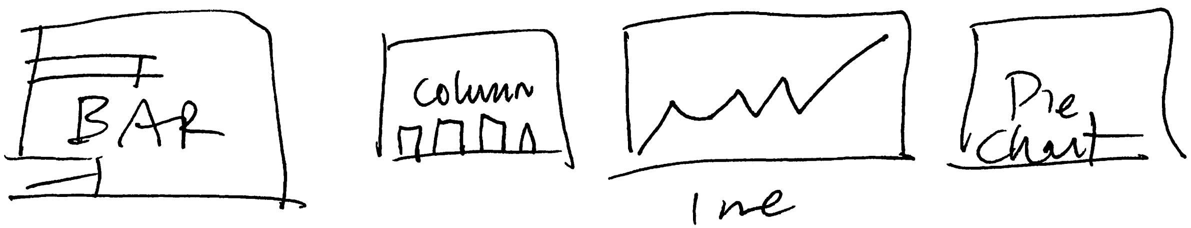
Here is a pie chart that shows how you spent your money

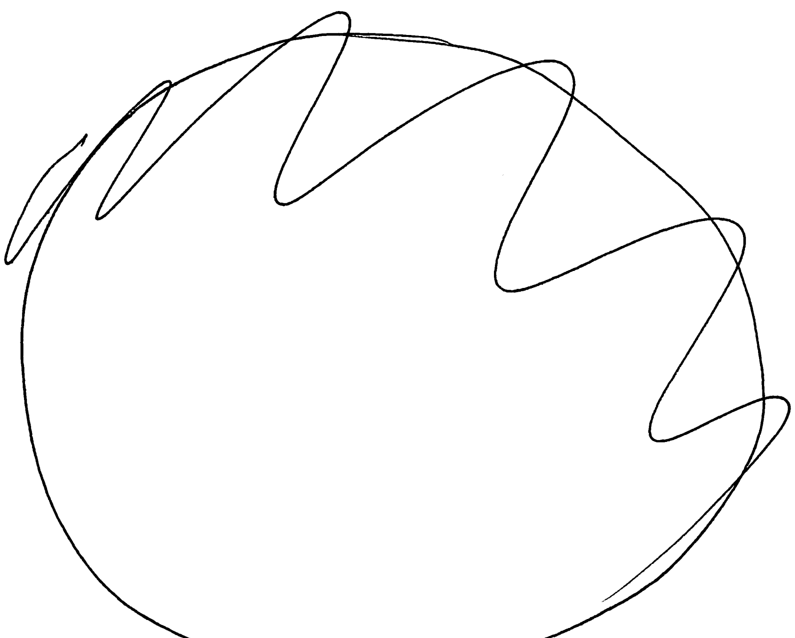


TYPE	AMT

COMPARE your choices to other visitors. This computer has kept a record of other people's choices. It will now take the information created in the spreadsheet, and compare it to other people's choices

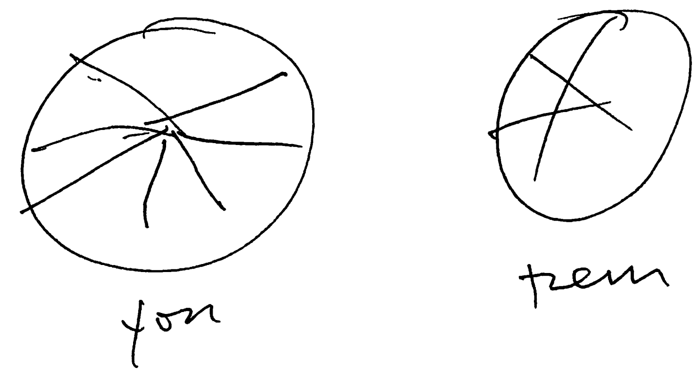
TYPE OF GRAPH → which chart give you the best info.

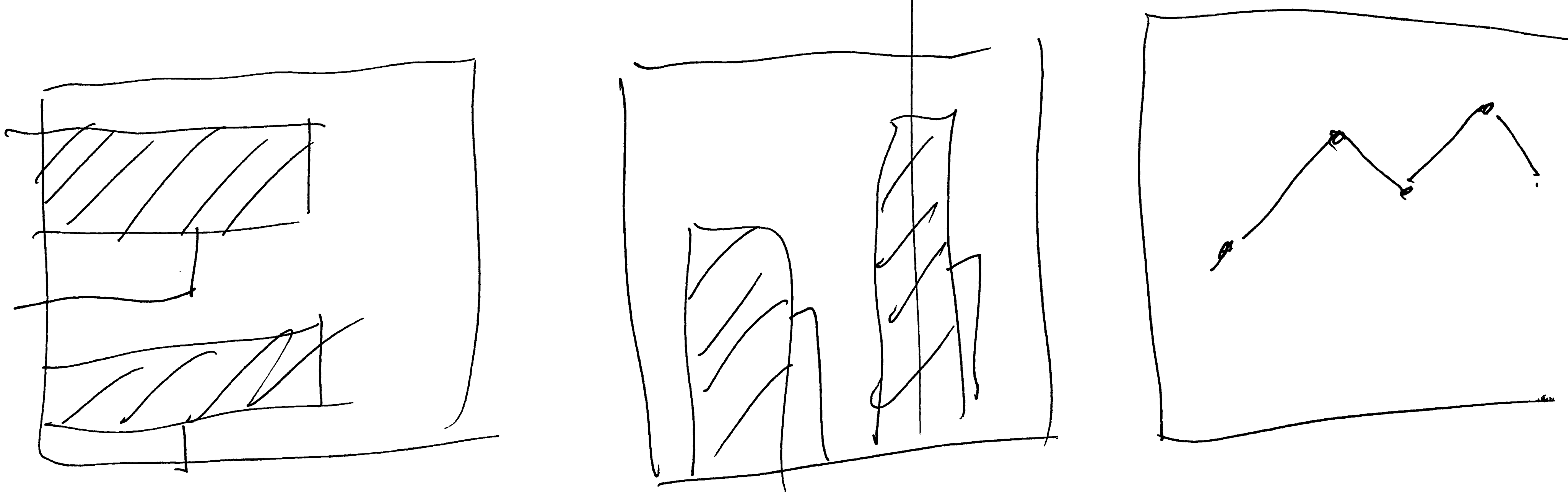




TYPE	AMT.

charts.



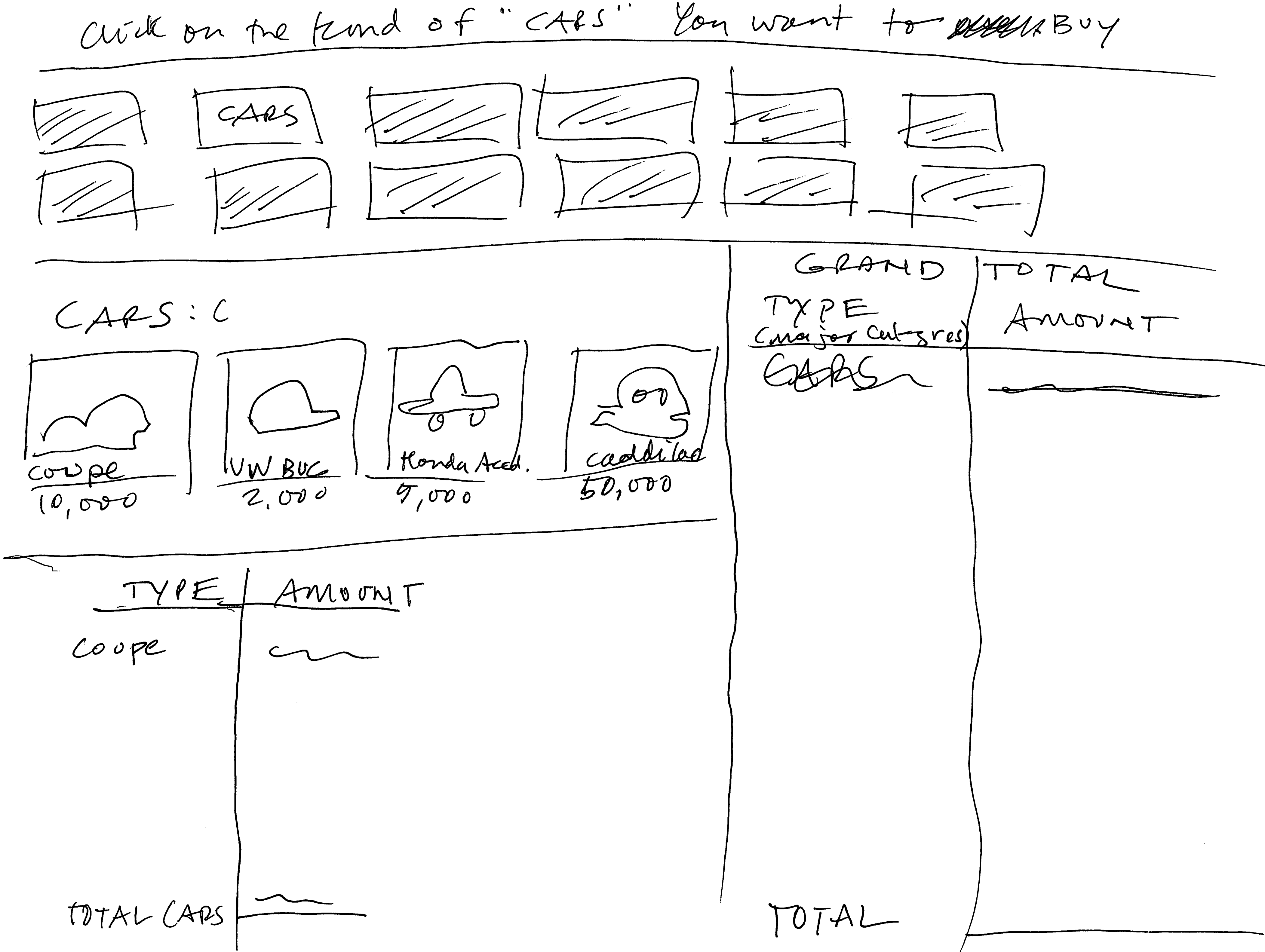


Attract screen: graphics of ~~[illegible]~~ bald man with money falling

"You have just won one million dollars...

Come on over and spend it."

An intro to spreadsheets + business graphics.

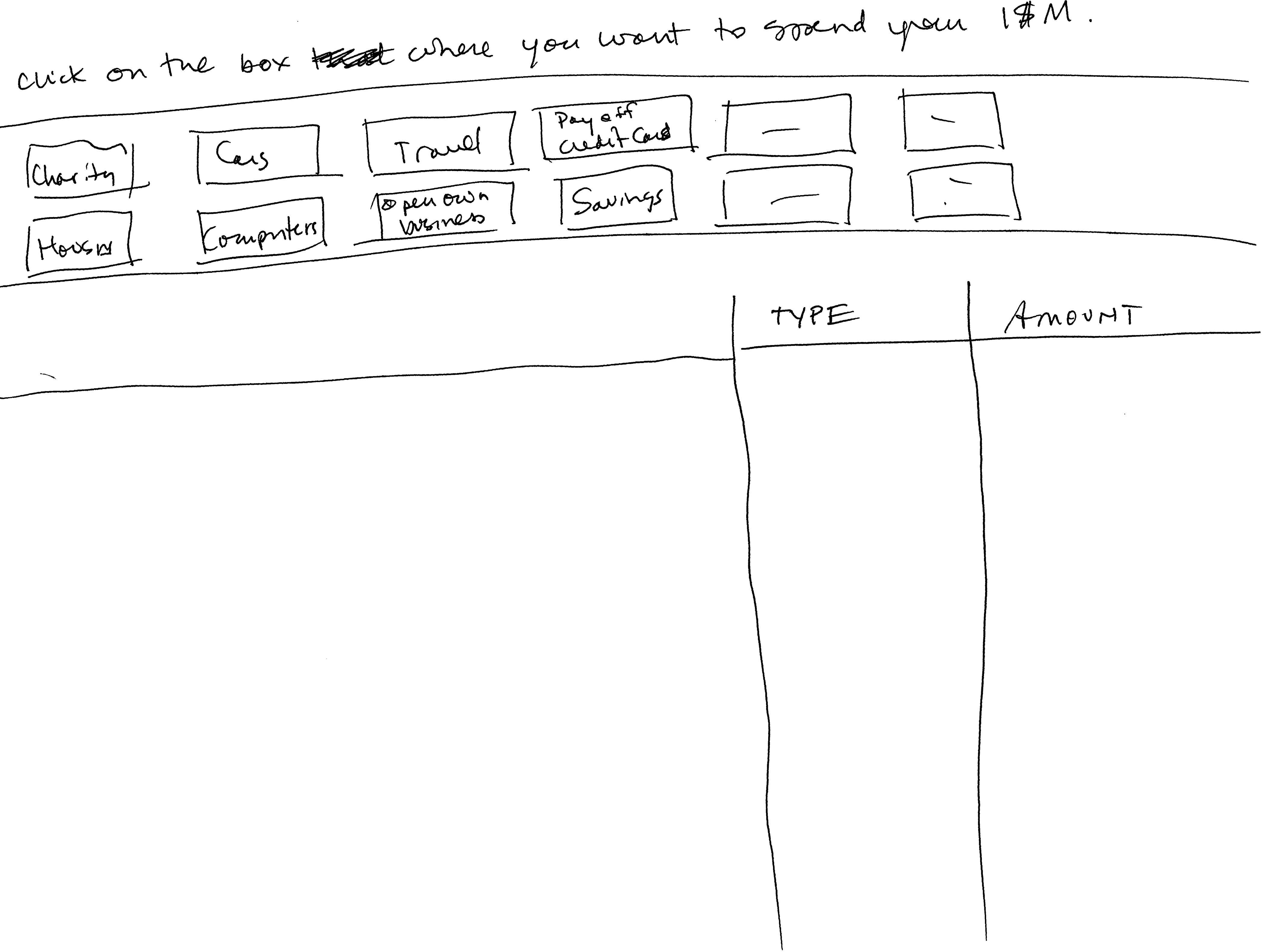


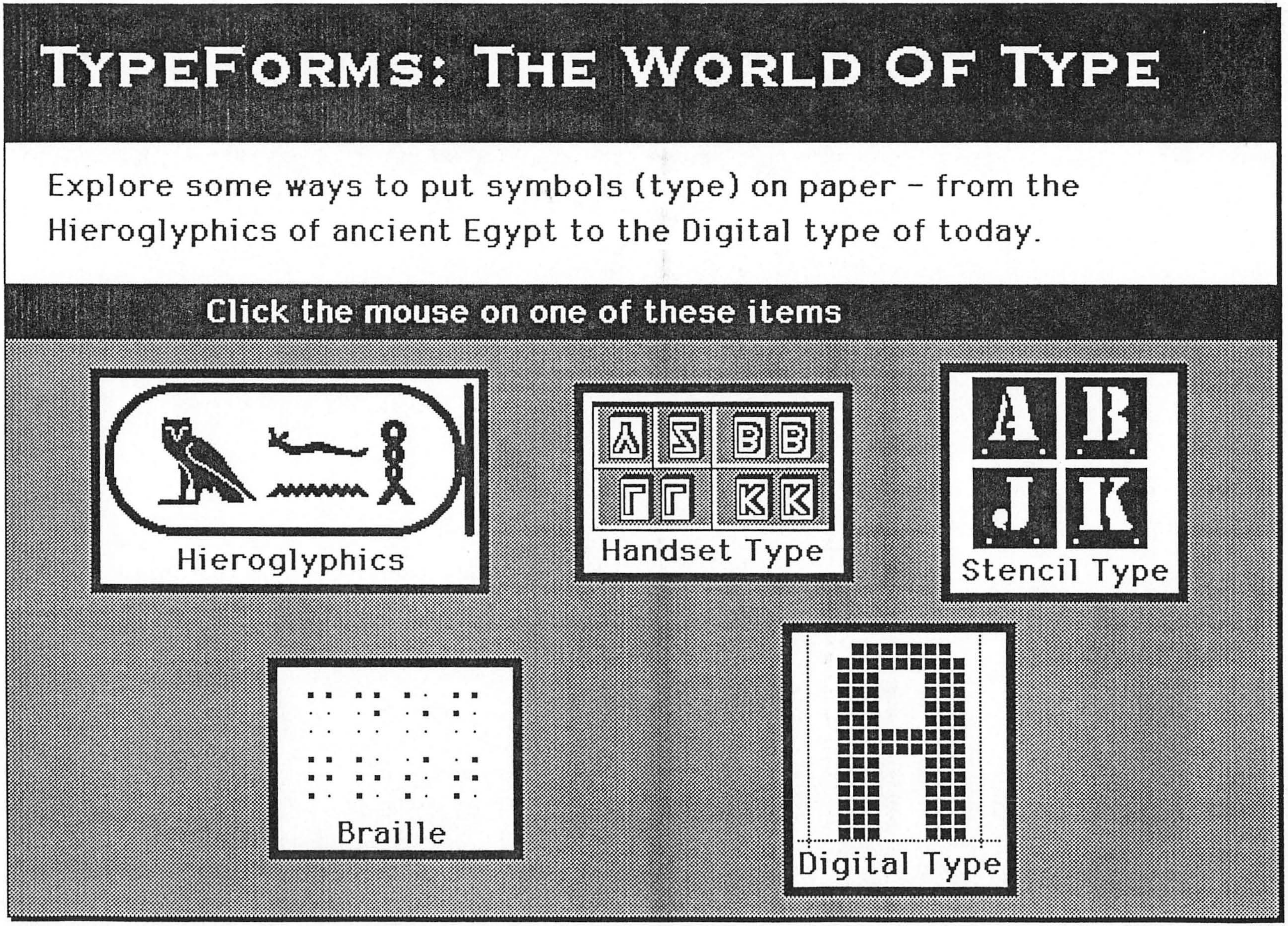
Click on the kind of "CARS" you want to BUY
CARS
CARS : C
coupe
10,000
VW BUG
2,000
Honda Accd.
5,000
caddilac
50,000
TYPE
AMOUNT
coupe
TOTAL CARS
GRAND TOTAL
TYPE (major Categories)
AMOUNT
CARS
TOTAL

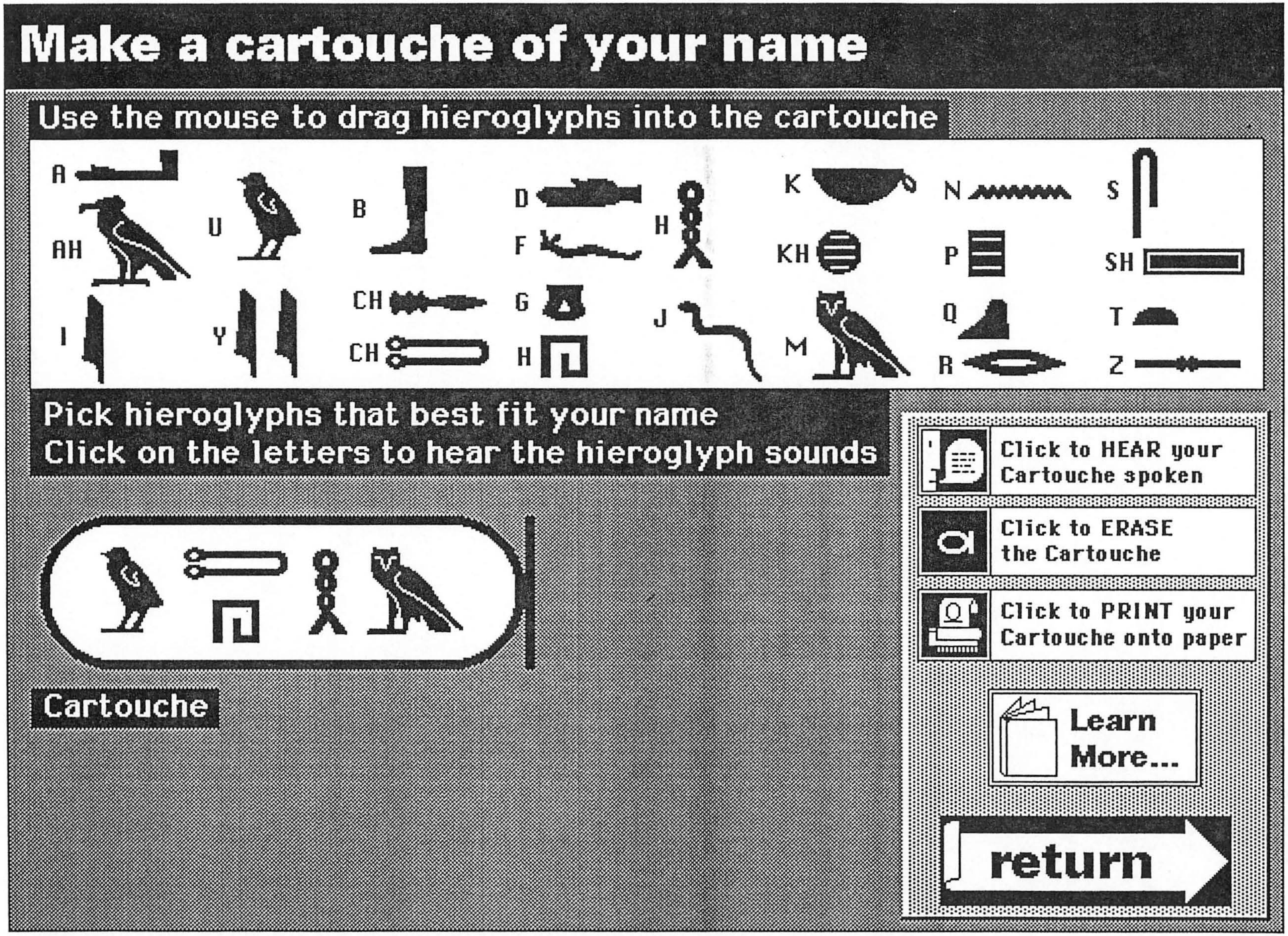
What would you do if you won one million dollars? Here's your chance to see what you would do, and compare your ~~answers~~ actions to those of fellow visitors.

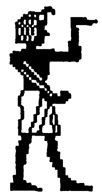
~~First, you'll use a spreadsheet to add up~~

Start by spending your 1 million dollars. You'll use a spreadsheet ~~so~~ to keep tabs of your spending habits. People use spreadsheet with computers ~~to~~ create order with their numbers. Each time you make a spending choice, it will show up on the computer.


Click on the box where you want to spend your 1$M.
Charity
Cars
Travel
Pay off credit card
Housing
Computers
Open own business
Savings
TYPE
AMOUNT


TYPEFORMS: THE WORLD OF TYPE
Explore some ways to put symbols (type) on paper - from the Hieroglyphics of ancient Egypt to the Digital type of today.
Click the mouse on one of these items
Hieroglyphics
Handset Type
Stencil Type
Braille
Digital Type


Make a cartouche of your name
Use the mouse to drag hieroglyphs into the cartouche
A
AH
I
U
Y
B
CH
CH
D
F
G
H
H
J
K
KH
M
N
P
Q
R
S
SH
T
Z
Pick hieroglyphs that best fit your name
Click on the letters to hear the hieroglyph sounds
Cartouche
Click to HEAR your Cartouche spoken
Click to ERASE the Cartouche
Click to PRINT your Cartouche onto paper
Learn More...
return



The Story of Hieroglyphics

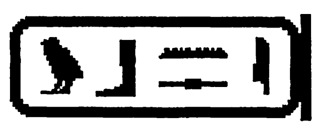
For 3500 years in ancient Egypt **hieroglyphs** were used as the sacred language of the **pharaohs**. Their use was ended in the year 384 by a decree of a Roman emperor. For 1400 years after that no one remained who could read the hieroglyphs that were seen on tombs and monuments.

The mystery was finally solved in 1822 when the Frenchman **Champollion** deciphered parts of the **Rosetta Stone**. He was able to translate the royal names of King **Ptolemy** and Queen **Cleopatra** that appeared in oval frames, or **cartouches**.

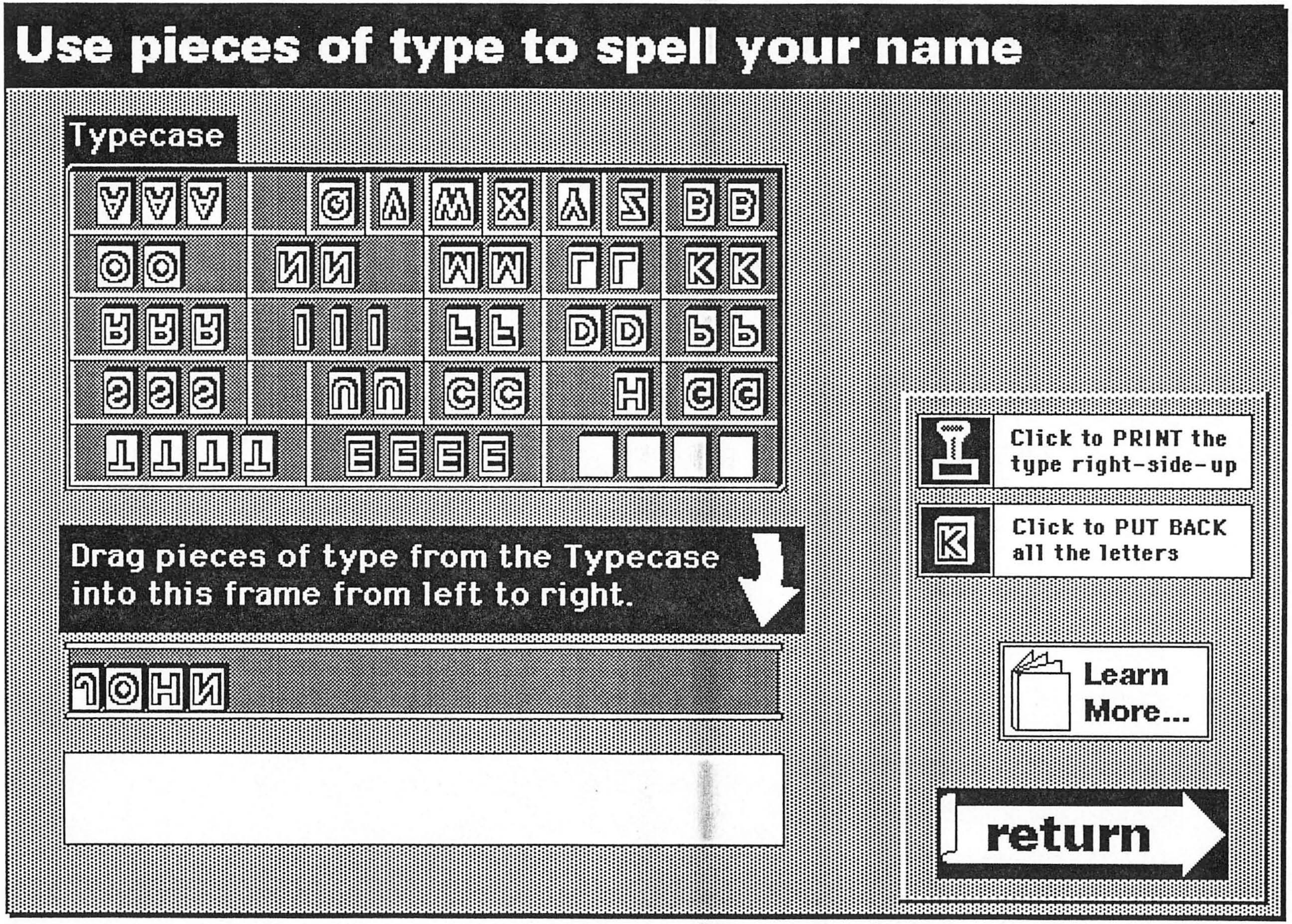
H 

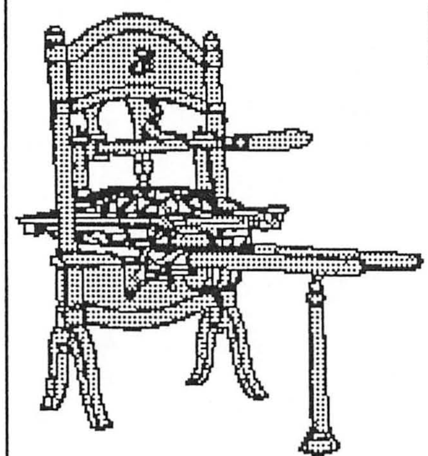
Some hieroglyphs represented sounds and some were symbols for things. In this demonstration the hieroglyphs represent single sounds (some of which don't exist in English!).

Here the hieroglyphs go left-to-right, though they could have been written right-to-left. (You know where to start reading by noticing which way the animals or people are facing!)



Click this screen to continue


Use pieces of type to spell your name
Typecase
Drag pieces of type from the Typecase into this frame from left to right.
Click to PRINT the type right-side-up
Click to PUT BACK all the letters
Learn More...
return

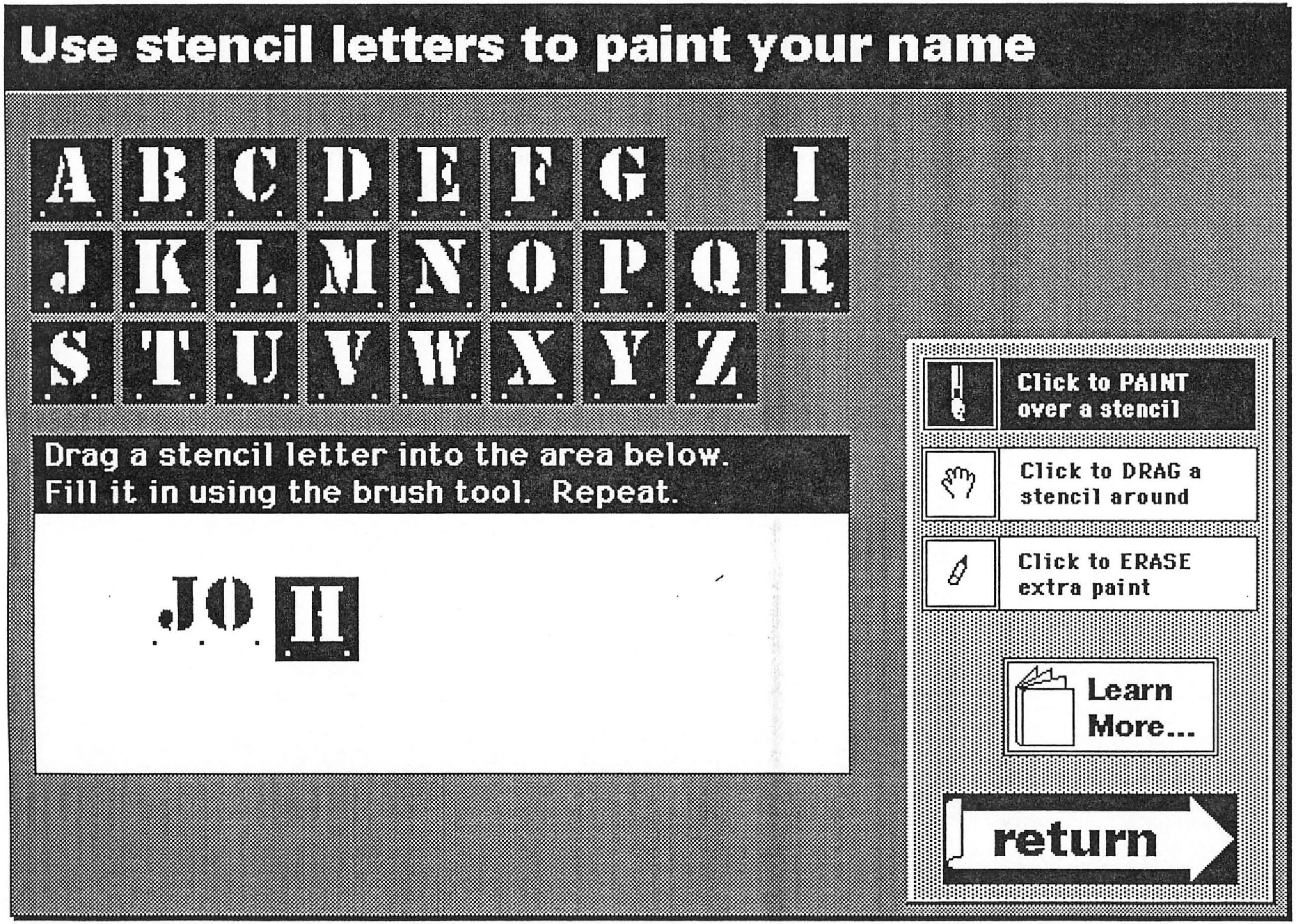


The Story of Handset Type

The printing industry began in the 1400's in Mainz, Germany where Johann Gutenberg invented a reusable mold for metal type. In order to print books in quantities, it was necessary to produce type that was moveable, reusable, and that would form an even line on a page. Gutenberg's mold could produced such pieces of type. Gutenberg, a goldsmith, also concocted his own formula for the metal that would be most suitable for type.

This exhibit shows you the kind of case in which metal type was stored. You can place these metal letters in a frame just as the printers did in Gutenberg's time. Imagine working with letters that had to be read upside down! It must have been a slow and difficult job to set a page of type.

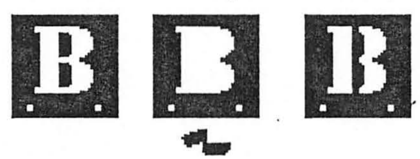
Click this screen to continue


Use stencil letters to paint your name
A B C D E F G I
J K L M N O P Q R
S T U V W X Y Z
Drag a stencil letter into the area below.
Fill it in using the brush tool. Repeat.
JOH
Click to PAINT over a stencil
Click to DRAG a stencil around
Click to ERASE extra paint
Learn More...
return

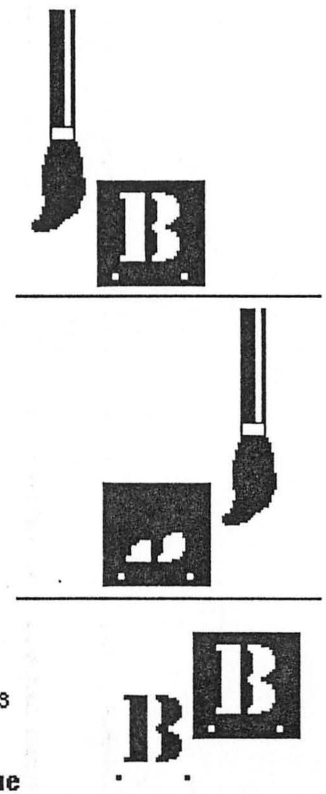
The Story of Stencil Letters

A stencil letter is formed by cutting its shape out of a background. These shapes are filled with color. When the stencil is removed, only the colored letter shape will remain behind.

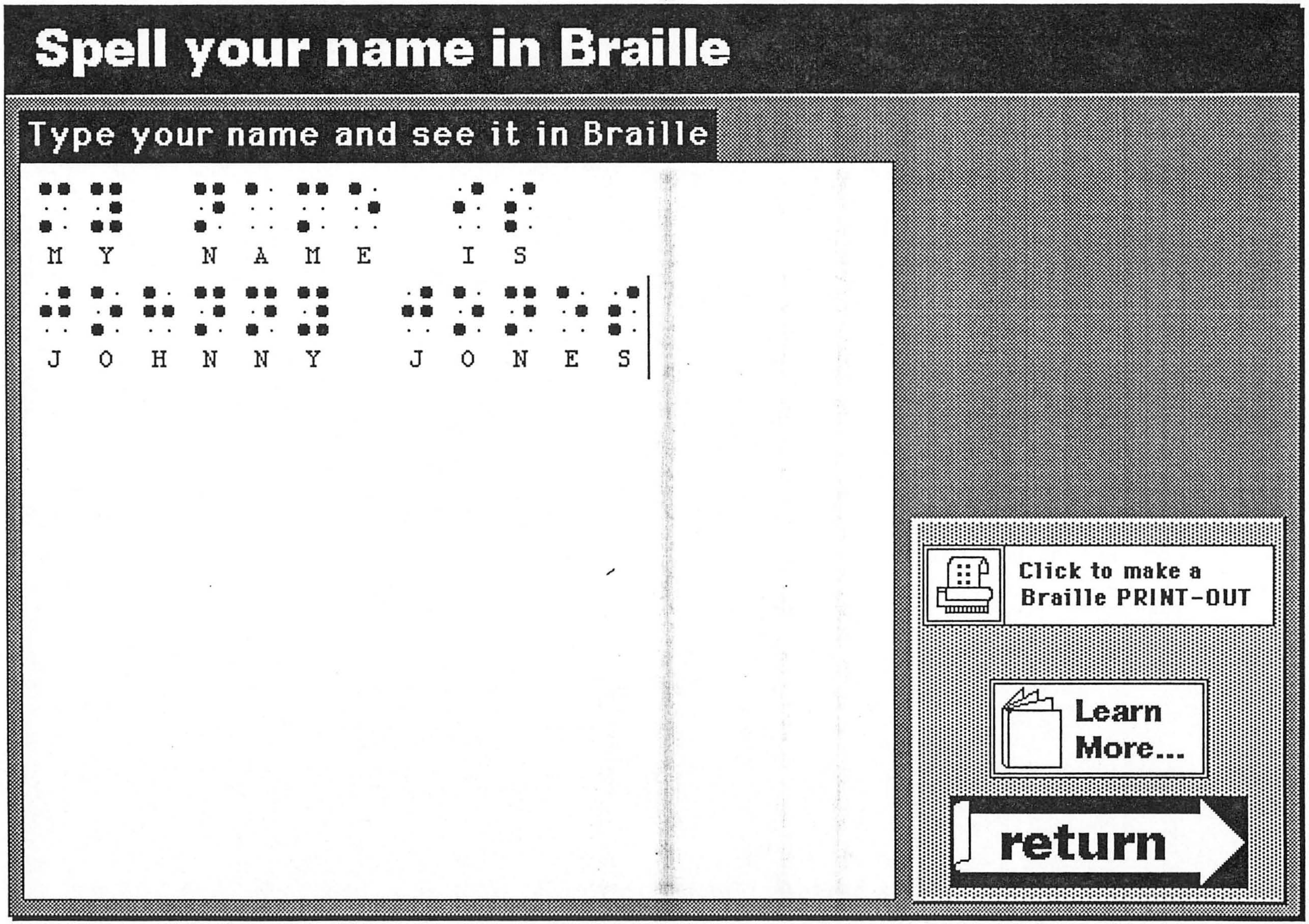
Stencil letters have shapes that are different from other letters. If a stencil were cut in one piece like an ordinary letter, its inner shape would not be attached to anything and would fall off. Therefore, a stencil letter is cut as two or more separate parts so that its inner and outer shapes remain attached.

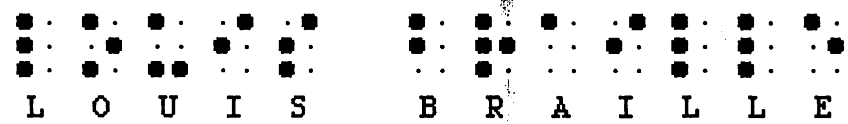


Stencilling is one of the oldest of printing techniques. It is particularly useful for printing directly on surfaces such as fabrics and walls.



Click this screen to continue


Spell your name in Braille
Type your name and see it in Braille
M Y N A M E I S
J O H N N Y J O N E S
Click to make a Braille PRINT-OUT
Learn More...
return



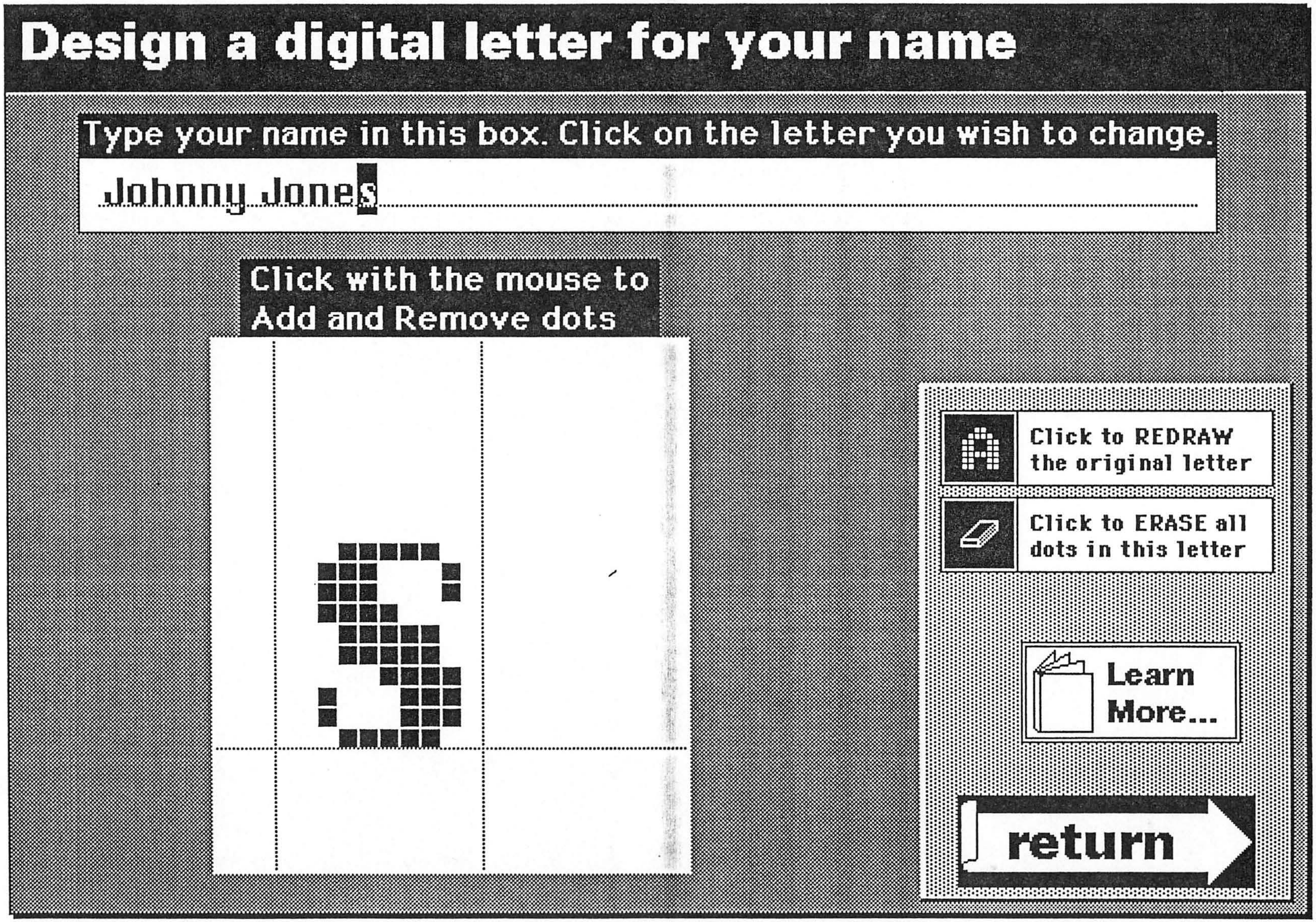
The Story of Braille

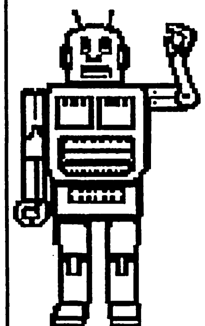
In nineteenth century France, Louis Braille developed a reading and writing system for the blind. This system known as braille includes signs based upon six raised dots arranged in all possible combinations. It was Louis Braille's intent that his dot alphabet be simple enough to be read by the touch of a fingertip.

This exhibit lets you type individual letters and see a letter by letter translation into the braille dot alphabet. Braille, however, also includes shorthand symbols for commonly occurring words, punctuation marks, accent marks for foreign languages, notes for musical scores, and mathematical and chemical notations.

Today, the production of braille documents are aided by optical scanners and voice recognition systems on Personal Computers. A hundred and forty years after Louis Braille's death, braille continues to be a vital resource for the blind enabling them to participate equally in this information age.

Click this screen to continue

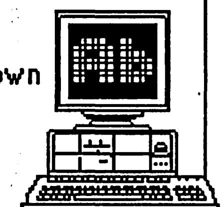

Design a digital letter for your name
Type your name in this box. Click on the letter you wish to change.
Johnny Jones
Click with the mouse to
Add and Remove dots
Click to REDRAW
the original letter
Click to ERASE all
dots in this letter
Learn
More...
return

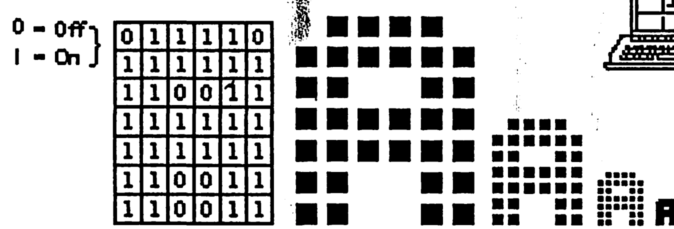


The Story of Digital Type

The letters you see on the computer screen are built of tiny dots called **pixels**. Pixels are either on or off (black or white). Normally, pixels are too small to see clearly, but in this program they are specially enlarged so you can see them.

With a computer, you can easily design your own letters on the screen.





Click this screen to continue

Overall Content

The following list gives a brief overview of the exhibits and demonstrations in the images and animation section of the exhibition.

The visitor's first view of the show is a 60-foot mural created by Harold Cohen and his assistant, a program called AARON which runs on a VAX 11/750. Mr. Cohen also has a human assistant, Linda Winters.

The system which creates this original art is a computer. The computer and 4 drawing machines will be on display churning out 'original art'. The works are interesting and remind friends of Mr. Cohen of his own pieces before he decided to program his computer to do the work for him.

Mr. Cohen has displayed his works in major galleries worldwide.

STANDALONE EXHIBITS

(1) "Warpitout" Jane Veeder, Chicago

Jane Veeder is a Chicago video artist who got interested in computer graphics through video synthesis. "Warpitout" was first exhibited at the 1982 SIGGRAPH art exhibit in Boston.

As the name suggests, the object of the piece is to warp 'it' out, the 'it' typically being your own face. "Warpitout" is extremely interactive. You sit in front of a television screen with a video camera overhead and take snapshots of your face. This image is stored digitally. Once you are satisfied with your image, you select the colours that best suit you. You then start altering your image in drastic ways - enlarge the nose, alter the edges, add a new mouth, and so on.

The system works on a microcomputer designed for real-time graphics and animation :

ZGRASS language
Datamax UV-1 Graphics Computer and Digitizer
Electrohome television monitor

(2) Colour Matching, Ontario Science Centre

Want to test your colour vision. Try matching this colour. The computer selects a colour at random from its palette of 16.7 million shades. You have to try to match it. You have 4 ways to choose from

Red Green Blue	Most colours can be synthesized by combining red, green and blue light
Cyan Magenta ~~Blue~~ Yellow	The complementary colours of red, green and blue. They are called the 'subtractive' primaries because they subtract colours from white light.

Hue Saturation Value	The colours in a paint book are organized this way
National Research Council	You select a colour from a palette of colours at constant brightness. There is a separate brightness control.

This exhibit is the result of collaboration with the National Research Council of Canada. They, like many computer labs, are interested in the easiest way to select specific colours in a computer graphics system.

Configuration

Motorola 68000
C language
Harmony operating system
Matrox frame buffer

(3) Touch Draw, Ontario Science Centre

This is a simple drawing program. You touch the menu to choose the object you want to draw - rectangle, circle, line, polygon - and then you place the object in the drawing area on the screen. It demonstrates a small sample of the graphics capability of Telidon, Canada's videotext system.

Configuration

Z80
C language
Telidon terminal
Eleographics touch sensitive screen

(4) PAINT, Ontario Science Centre

A paint program is a computer program for handpainting two-dimensional images in full colour. It is modelled on the traditional artist's setup. However, since the 'canvas' is a piece of digital memory displayed on a normal television monitor, it is easier to make changes to the painting. The program simply stores a copy of the display and has no knowledge of any objects in the picture.

In this paint program you draw on an electronic touch tablet. The paint appears on the computer screen. There are many colours and brush designs to choose from.

Paint programs are becoming very popular. They are now used in television studios to 'touch up' the video image. Animation programs, such as Tween, use them to colour the cartoons. And artists use them to create new images.

(5) Fractal Play Ontario Science Centre

Benoit Mandelbrot, of the IBM Thomas J. Watson Research Centre, coined the word 'fractal' to describe a new geometry which turns out to be very useful in computer graphics for creating natural forms - plants, mountains, coastlines, and so on.

You can experiment with this mathematics to try to create a realistic coastline or a mountain range. Or you can scan through some of the images generated with this technique at Lucasfilm Ltd.

The program is based on a prototype developed by Alain Fournier at the Computer Systems Research Institute, University of Toronto.

The display around the exhibit describes the technique and shows works by Richard Voss of the IBM Thomas J. Watson Research Centre. One of the images "Mount Mandelbrot" is part of the 1983 SIGGRAPH art show.

Configuration

VAX 11/750 operating under Berkeley Unix 4.2
Norpak Video Display Processor (512x512x24)
C language

(6) " Star Rider" — Atari Arcade Game

This arcade game fits in with the section on visual simulation. You drive through space. The scenes and challenges change quickly both ahead and behind (which you watch through your rear view mirror).

(7) Image Theatre

Drop in and watch some of the most astounding images yet created with a computer - in art, in commercials, in science. An hourlong program has been carefully selected from artists/programmers from around the world.

(8) Animation Theatre

Watch two remarkable computer-animated films:

"Hunger" — Peter Foldes, National Film Board

A very fine example of the technique known as keyframe animation. The artist does the key frames; the computer does all the in-betweening. The software was developed by N. Burtnyk and Marcelli Wein at the National Research Council of Canada.

"Dream Flight" — Philip Bergeron, University of Montreal
Nadia Thalmann
Daniel Thalmann

A fantasy film generated by a graphics language called MIRA, an extension of Pascal, and displayed on a Tektronix 4027.

(9) Rocking Cube, — Douglas Back
Ontario College of Art

An art installation exploring the relative nature of our view of the world. The fine balances are controlled with an Apple microcomputer.

(10) R Matrix, Dennis J Vance
Vancouver

Walk through a space. Use your motion to create different sounds and images. Find the hidden rewards.

This installation has two banks of lights, and two banks of sensors arranged on opposite sides of a large square matrix (8 x 8). It operates from an Atari 800.

(11) Arcade Dennis J Vance
Vancouver

This is a piece for 4 players. You each play music with a very simple touch panel. Together you can discover musical secrets.

It operates from an Atari 800.

(12) Binary Counter, Jim Pallas
Detroit

A very unusual binary counter, guaranteed to delight.

(13) "Progmod" Jim Pallas
Detroit

A sound and light sculpture that uses radar, a microphone, and a photocell to pick up and react to your presence.

(14) Sound Sculpture Sandor Ajenstat
Ontario College of Art

A finely balanced piece which reads a tape in a most unusual manner - the recorder moves up the tape.

(15) Ladder Michael Hayden

(16) Neon Circles Michael Hayden

(17) "Computer Eyepiece", Michael Naimark

An art piece first exhibited in the 1983 SIGGRAPH art show in Detroit.

A 16mm film loop and frosted acrylic dome produced with the Chroma-chron digital image processor of Raster RSRCH Inc, in collaboration with Ed Tannenbaum

(18) Matrix One Norman White
Ontario College of Art

(19)___________ Norman White
Ontario College of Art

(20) 1983 SIGGRAPH art show

Approximately 55 computer-generated art pieces selected by a jury for the 10th annual conference of the Special Interest Group in Computer Graphics, Association for Computing Machinery.

The show includes a 1-hour videotape with works by 20 artists.

STAFFED EXHIBITS

(1) Telidon Images

Telidon is Canada's videotext system. In this exhibit you can talk to picture creators who use the technology to create both artistic works and information pages for communicating general information to the public.

You can also look at works selected from artists across Canada.

Configuration

Norpak Information Provider System
Createx software

Microtel terminal linked
to VAX 11/750

(2) Animation (TWEEN)

Tween , from the New York Institute of Technology Computer Graphics Lab, is a computer-assisted animation system. It does inbetweening by linear interpolation, inking, creation of exposure sheets and a realtime pencil test to check the animation.

The various features will be demonstrated by skilled animators.

A selection of works by artists at the New York Institute of Technology will be displayed nearby.

Configuration

PDP 11/44 operating under Unix
Vector Automation display
Summagraphics bit pad

(3) Solid Modelling

Have you ever dreamed of flying an F-16 ?

With this system the visitor becomes the pilot in an exciting trip through the mountains. Or with the same system, the visitor can design 3-dimensional objects and move them around in realtime.

Configuration

VAX 11/750 operating under Unix
Iris work station

(4) Images Workshop

The workshop is set up for visitors to come in, sit down and explore numerous small systems for creating images, telling stories, producing a short movie, and so on.

The emphasis is on small systems and affordability.

It includes the following programs which run on the Apple II/e , Commodore 64, Mackintosh, Sony SMC-70, and Atari 800

Movie Maker

MacPaint

Face Maker

Story Machine

Micro Illustrator

Graphics Editor

View Titles

Magic Voice

In addition, the LOGO language will be running on the DEC Pro/350. This language, created by Seymour Papert at the Artificial Intelligence Lab of the Massachusetts Institute of Technology, encourages very young children to explore abstract concepts in an experiential way.

STATIC EXHIBITS

SIGGRAPH 83 Art Show
new installations
The best of Telidon
The best commercials (computer-generated)
SIGGRAPH tapes
Fractals

FILMS

"Hunger", NFB
"Vol de Reve", University of Montreal
latest computer images
flight simulations
dissection of a Richard Voss landscape (Mount Mandelbrot)

1. Introduction

2. Match the Colour

2.1 Objective
2.2 Copy content for tablet
2.3 Copy content for display
2.4 Equipment

3. Seeing Colour

3.1 The Physiology of the Eye
3.2 Colour Deficiencies
3.3 Subjective Colour Phenomena

4. The Physics of Colour

5. Colour Technology - TV, Film, Video and Printing

Appendix A Images

Appendix B Artifacts

Colour Matching

First Draft

Keith Riordon

September 20, 1983

1. Introduction

The name of the exhibit 'Colour Perception' describes its prejudice - to focus on our perception of colour rather than on the physics of colour or the technology for producing colour. The centre of the exhibit is an interactive computer-driven display which tests the visitor's ability to match two colours. The evaluation is based on a person with normal vision. Anyone with colour deficiencies will have problems, though no less enjoyment. Section 2 describes the purpose of the colour matching, Section 3, the nature of the eye and colour deficiencies. Hopefully the two displays will be interesting enough that the visitor getting consistently poor results will do the colour blindness test.

Other surrounding displays describe briefly the physics of colour and the technology for producing colour.

2. Match the Colour

2.1. Objective

The more obvious goal of this exhibit is to test the visitor's ability to match a colour selected at random by the computer. The main, though at first sight less obvious, goal is to encourage the visitor to explore different colour selection systems and to introduce the concept of colour spaces.

There are many different colour systems being used. Four were chosen for this exhibit - RGB (Red Green Blue), CMY (Cyan Magenta Yellow), HSV (Hue Saturation Value) and a hybrid developed at the National Research Council in Ottawa. Traditional colour systems use 3 separate indicators. In the case of RGB and CMY, these represent the intensities of 3 primary colours for the additive (equal amounts of Red, Green and Blue produce white) and subtractive (equal amounts of cyan, magenta and yellow produce black) methods respectively. These two methods are equivalent - one is just the complement of the other. RGB is used in optics, CMY, in the print industry. Ultimately in computer graphics all the methods have to control the voltages of the red, green and blue guns of the monitor.

An artist would probably become very frustrated with both these methods. Trying to produce a colour like pink or brown is not intuitive with the RGB controls. Normally the artist chooses a pure hue, or pigment, and lightens it to a tint of that hue by adding white or darkens it to a shade by adding black. or, in general obtains a tone of that hue by adding some mixture of white and black, a gray.

The hexcone model (HSV) is an attempt to transform the RGB colorcube into a set of dimensions modeling the artist's method of mixing.

The fourth method, developed at NRC, integrates two of the three variables to produce a colour plane and an intensity control. The plane has red, yellow, green and blue in the four corners of the digitizing tablet. They are arranged in a hue circuit, with white in the middle, as suggested by opponent-colours theory. NRC claims that inexperienced users are able rapidly and reliably to find the colour they want with only a few minutes learning.

With all the methods, certain colours - browns, olives, navy blues - are hard to find.

2.2. Colour Spaces

This exhibit lends itself to 3D models of colour spaces, particularly the RGB colour cube, the HSV hexcone, and the Munsell space. The object is to stimulate people into thinking about colour definitions. Are paint patch books and English-type names really satisfactory when one wants to specify a colour from a natural scene ? The enclosed article by W.B.Cowan and Colin Ware describes the typical use of colour names and describes the 'Desert Island experiment'. We could consider doing the latter with a large container of pebbles which must be sorted according to some colour criterion. Copy around the HSV space should explain why the basically cylindrical co-ordinate system is displayed as a cone. If a colour is very light or very dark it cannot be fully saturated. Only colours of intermediate lightness can be vivid. The maximum possible saturation of a colour decreases as it becomes light or dark. This is the reason for the common description of the colour solid as a sphere or double cone rather than as a cylinder.

2.3. Copy content for Tablet

The copy on the tablet has to clearly define the controls for the exhibit and give credit to the National Research Council for assisting in the development.

The functions are as follows:

(i) Overall controls

START - return to introduction page

CHECK - evaluates colour match and allows visitor to correct the colour

HELP - displays an explanation of the current colour

September 20, 1983

system

(2) Selection of a colour system

RGB - selects the RGB indicators

CMY - selects the CMY indicators

HSV - selects the HSV indicators

NRC - selects the NRC system

The credit could be roughly as follows:
" This exhibit was developed with the cooperation of the National Research Council, Ottawa and is based on a prototype seen there in October, 1982. Both the Computer Graphics Lab, University of Waterloo, and the Computer Systems Research Group, University of Toronto also contributed ideas. It represents research which is very fundamental to the whole field of computer graphics."

2.4. Copy Content for Display

Currently the exhibit has an introduction page and one tutorial page for each of the four colour systems. The evaluation is superimposed on the main display which includes the two colour patches (a rectangle in a rectangle) and a status area showing the indicators for the chosen colour system. John Voskuil has made some valuable suggestions for both the tablet copy and the main display, which will be incorporated before the exhibit is installed.

Introduction page

Colour Perception

This exhibit illustrates the use of different colour systems to select colour.

Using the controls on the tablet, try to match the colour of the inner region to the colour of the outer region.

The upper buttons select a new colour system. You can choose the Red-Green-Blue system, the Cyan-Magenta-Yellow system, the Hue-Saturation_Value system,

or a system developed at the National
Research Council of Canada.

When you think you have matched the
colours, press CHECK & CORRECT, and
you will see how well you did. You can
then correct your errors, or start
again.

PRESS THE BIT PAD TO CONTINUE

Tutorial Pages

Each tutorial page, except for the NRC one, contains both text and a colour illustration of the colour space.

(1) RGB

THE RED-GREEN-BLUE COLOUR SYSTEM

Most colours can be synthesized by
combining red, green, and blue light.

The red-green-blue (RGB) colour system
varies the intensities of these three
"primaries" to produce a colour.

For instance, when
bright red light is
mixed with bright
green light, a yellow
colour is produced.

If you mix all
three of the
colours together
the result is a
gray or white
colour

(2)CMY

THE CYAN-MAGENTA-YELLOW COLOUR SYSTEM

Cyan, magenta and yellow are the comple-
mentary colours of red, green and blue.
They are called the "subtractive primaries"
because they subtract colours from white
light.

If you have ever mixed paints or used

filters, then you have been using a subtractive colour system.

As you increase the subtractive primaries you reduce the amount of "reflected" light, and the resulting colour becomes darker.

(3) HSV

THE HUE-SATURATION-VALUE COLOUR SYSTEM

It is easier to select a colour in the HSV system than in the RGB system, since hue, saturation, and value correspond to the way people arrange colours.

Hue is the pure colour you are using, such as orange or green.

Saturation is the amount of colour, or the depatrure from gray.

Value is the intensity or brightness.

(4) NRC System

A COLOUR SYSTEM DESCRIBED BY THE NATIONAL RESEARCH COUNCIL OF CANADA

The other colour systems in this exhibit are counter-intuitive to some degree, It requires a great deal of training to quickly and accurately pick out a colour using them.

In this system you control your position on a plane of colours of constant bright--ness by touching different areas of the large coloured square.

You can also change the brightness of the current plane using the bar indicator below the coloured square.

You should find that it is much easier to select colours in this system than in the others.

2.5. Equipment

The basic hardware configuration is based on a system developed at the National Research Council of Canada, designed to be operated under the Harmony operating system developed by Morven Gentleman. We have chosen the same chassis and CPU to speed up our development. In addition, we require a frame buffer/colour lookup table combination to allow access to the full 16.7 million palette of colours. We should include some basic description of the colour generation mechanism. This is described in Section 4 under TV.

The system includes the basic hardware:

Part: MC-609E chassis, with PPRC8
Description: 9-slot Multibus compatible, rack mountable chassis with power supply, RFI filtering, dual fan cooling, and front switches. It includes the parallel priority option.

Dimensions:

Width	19.0 in.	(43.3 cm.)
Depth	17.5 in.	(41.9 cm.)
Height	7.0 in.	(17.8 cm.)
Weight	27 lbs.	(12.3 kg.)

Power Supply: Output power 300 watts maximum

volts	Imax	volts	Imax
+5	40.0A	+12	3.0A
-5	150mA	-12	2.8A

Supplier: Transduction Ltd.

Part: Hitachi 19" monitor

Description: High resolution RGB monitor

Dimensions:

Power Supply:

Supplier: Megatronix

The chassis contains the following Printed Circuit Boards:

PCB: OB68K1A

Description: MC68000/ IEEE-796 (MUltibus) single board computer

Supplier: Omnibyte Corporation
245 W. Roosevelt Rd.
West Chicago, Il 60185

September 20, 1983

(312) 231-6880

PCB: RGB-Graph 64/4

Description: frame buffer (2 boards for 512x512x8) / graphics processor

Supplier: Matrox electronic systems Ltd.
5800 Andover Ave.,
T.M.R., Quebec
Q4T 1H4

PCB: VAF-512/8

Description: real time frame grabber, colour lookup table (permits display of 256 colours from a palette of 16.7 million)

Supplier: Matrox electronic systems Ltd.

PCB: RGB-Alpha SL

Description: colour alphanumerics board for character generation

Supplier: Matrox electronic systems Ltd.

PCB: BLC-8905

Description: Prototyping board for Multibus to contain the interrupt generators and mailboxes for the Harmony operating system

Supplier: Semad Electronics

3. Seeing Colour

The purpose of this display is to explain how the eye sees colour, and how the eye can be easily 'tricked' into seeing different effects under certain conditions. It includes the basic physiology of the eye, a short description of colour blindness with a chart for testing oneself, and a videotape or panel on different colour phenomena.

3.1. The physiology of the Eye

It is not accidental that colour systems, in general, use 3 parameters to obtain any colour. Until recently, it was firmly believed, as expounded by Helmholtz and Young, that the eye has three types of colour receptors - one for red, one for green, and one for blue. Clark Maxwell assessed Thomas Young's contribution in these words :

"It seems almost a truism to say that the colour is a sensation; and yet Young, by honestly recognizing this elementary truth, established the first consistent theory of colour. So far as I know, Thomas Young was the first who, starting from the well-known fact that there are three primary colours, sought for the explanation of this fact, not in the nature of light but in the constitution of man."

There is an illustration of Young's experiment in Gregory's book "Eye and Brain" (page 120). We should also include the colour response curves of the eye (page 121).

The theory of three principle colours, unfortunately, does not explain certain phenomena such as why the eye recognizes four fundamental distinct colours - red, green, yellow and blue.

3.2. Colour Deficiencies

About 10 % of the male population is colour defective in some way or another. The traditional explanation is that the colour defective observer lacks a dimension of colour response. This means that such an observer can get a perfect colour match with any two of the three colour primaries using an additive mixture. Recent observation shows that there appears to be a wider range of colour experience available to colour defective observers than was previously thought.

3.3. Subjective Colour Phenomena

The videotape from the Computer Graphics Lab, University of Waterloo, summarizes subjective colour phenomena -

simulataneous contrast
depth
temperature
etc.

The 'Match the Colour' exhibit demonstrates the first phenomena very well, where the fixed background appears to be changing colour.

4. The Physics of Colour

Newton was the first to show that white light is made up of all the spectral colours. We may want to reproduce the experiment with the prism. After the development of the wave theory of light it was shown that each colour corresponds to a given frequency. We can demonstrate this with an illustration of the electromagnetic spectrum.

5. Colour Technology - TV, Film, Video and Printing

It is difficult to isolate the colour of an object from the medium or material. Much effort has gone into attempts to translate the colour off a television monitor to the same colour on some form of hard copy. This is not a trivial task, particularly since each industry has different standards. The people producing TV monitors and the people producing colour printers use quite different techniques.

I would like a small display on colour as it is used in different environments from the printing industry to the paint industry to surround a thorough description of the colour generation technique used in the 'Match the Colour' exhibit. It could include paint patches, colour dictionaries, film, printing inks, etc. each with a very brief description of how a particular colour is produced.

<u>Television/Video</u>

A normal home television can become the display for a computer graphics system, provided some circuitry is added for character and line generation. It is not useful in many applications because of the limited resolution. Resolution refers to the number of individual picture elements (pixels) that can be displayed on the screen. An ordinary television can handle roughly 72,000 pixels (300 lines by 240 elements per line), considered nowadays to be low resolution. The television in the 'Match the Colour' exhibit can handle roughly 390,000 pixels (720 lines by 540 elements per line), considered to be medium resolution. The resolution and the price are closely related.

Colour information can be transmitted in various ways. First, there is the RGB type monitor where there are three separate signals of red, green and blue to contain the colour. Then there are numerous methods which encode the colour information into one signal. All encoding schemes use luminance (or the grey scale of the three colours) on a wide band signal with the other information, called chrominance, on a narrower-band signal. Because the RGB uses three full bandwidth signals the colour is significantly better than any encoded scheme. In the US, Canada, Japan and South America the NTSC scheme, defined by the National Television System Committee in 1953 is used. Computer people refer to it jokingly as Never Twice the Same Colour.

Most current computer graphics displays are based on television technology. They are referred to as raster displays, since the image is formed from a raster, a set of horizontal raster lines each made up of individual pixels; the raster is simply a matrix of pixels covering the entire screen. The entire image is scanned out sequentially , 30 times a second, one raster line at a time top to bottom, by varying only the intensity of the electron beam for each pixel on the line. The entire image is stored in memory reserved for the screen and referred to as the refresh buffer. Until the development of solid-state technology raster displays were limited by the price of memory. A 512x512 black and white image requires 262,144 memory locations (bits). To add colour, or grey scales this increases exponentially :

512x512x1	2x1	2 colours
512x512x2	2x2	4 colours
512x512x3	2x2x2	8 colours
512x512x4	2x2x2x2	16 colours
......		
......		
......		
512x512x8		256 colours
......		
......		
......		
512x512x16		16.7 million colours

In the 'Match the Colour' exhibit it is possible to generate 16.7 million colours.

Film

Please read the enclosed article by John A.

September 20, 1983

Blunden, "Fundamentals Of Color Film Technology". We should contact the Eastman Kodak Company for possible material on the development of colour film.

Printing

There are two aspects of printing that relate to computer graphics - printing directly from the computer to a printer, and conventional printing. For the latter, we can use material from the existing printing exhibit, particularly the dyes used to generate colour. For extra information read the enclosed article by Robert Kushner, "Ink and Paper and Their Relationships to Color Perception". Perhaps we could also include samples of press sheets in each of the 4 colors of lithography, as well as the combination of all colours.

There are 5 major types of colour graphics printers that can be used to transfer CRT images directly to paper. These are:

(1) impact printers

This device uses multiple coloured ribbon to print the colour on standard paper.

(2) ink jet printers

This device sprays ink on the paper. Usually three inks - cyan, magenta and yellow - are used.

(3) thermal printers

This process uses three coloured ink sheets and a thermal head to transfer the image to special paper.

(4) xerography

The Xerox 6700 allows three colours to be transferred to paper. A laser is used to copy the image onto the xerox drum which then goes through the toners and is transferred to paper.

(5) electrostatic printers

Versatec has announced a colour plotter using the electrostatic principle.

There are also devices for transferring the images directly to film. It would be interesting to display the same image using all the different methods. This would certainly get across the difficulty in reproducing exact colours.

September 20, 1983

Appendix A Images

This exhibit lends itself to colourful images ranging from subjective colour phenomena to fine art.

The following list comprises those that I feel are essential :

Views of the RGB colour cube
Views of the HSV hexcone
The three intersecting primaries for
  additive (RGB)
  subtractive(CMY)
Scale of Saturation levels bounded by fully
  saturated red and fully desaturated white
Illustration of a raster display
Chart for testing colour blindness
Chart of visible spectrum (4000 to 7000 A)

Appendix B   Artifacts

The purpose of all the artifacts and images is to start the visitor thinking about colour. The following artifacts would be helpful:

3D models   RGB Colour Cube
HSV Hexcone
Munsell colour system

Paint Colour Book

Colour Dictionary

Printing dies

Finger Paints

Live spectrum (Light + prism)

Filters

Kodak artifacts on film (contact Kodak)

Textiles/Ceramics

a Piet Mondrian reproduction(e.g. "Broadway Boogie Woogie"

videotape of subjective colour phenomena (using colour to create distance, temperature, contrast, etc.)

How many colours are offered in each medium - dyes, paints, prints, etc. ?

September 20, 1983

References

A. Maerz and M. Paul, "Dictionary of Colour", McGraw-Hill, New York, 1930, 1950

U.S. Dept. of Commerce, National Bureau of Standards, "Color: Universal Language and Dictionary of Names", NBS Special Publication 440 , US Government Printing Office, Washington, D.C., S.D. Catallog No. C13.10:440, 1976

The Munsell Book of Colour

R.L. Gregory, "Eye and Brain the psychology of seeing",

World University Library, 1972

Birren, F., ed. "The Elements of Colour: Munsell", New York: Van Nostrand Reinhold Company, 1969

Birren, F., ed. "The Elements of Colour"", A treatise on the Color system of Johannes Itten based on His Book The Art of Color. Translated by Ernsr Van Hagen, New York: Van Nostrand Reinhold Company, 1970.

Itten, J., "The Art of Color". The Subjective Experience and Objective Rationale of Color. Translated by Ernst Van Hagen. New York: Van Nostrand Reinhold Comapny, 1973.

Joblove, G.H. and D.P. Greenberg "Color Spaces for Computer Graphics", Computer Graphics, v.12 (Aug. 1978):20-25