Binary Clock Cube Design

Designers	André Boulouard	Walter Randelshofer
WebSites	http://www.mementoslangues.fr/	http://www.randelshofer.ch/

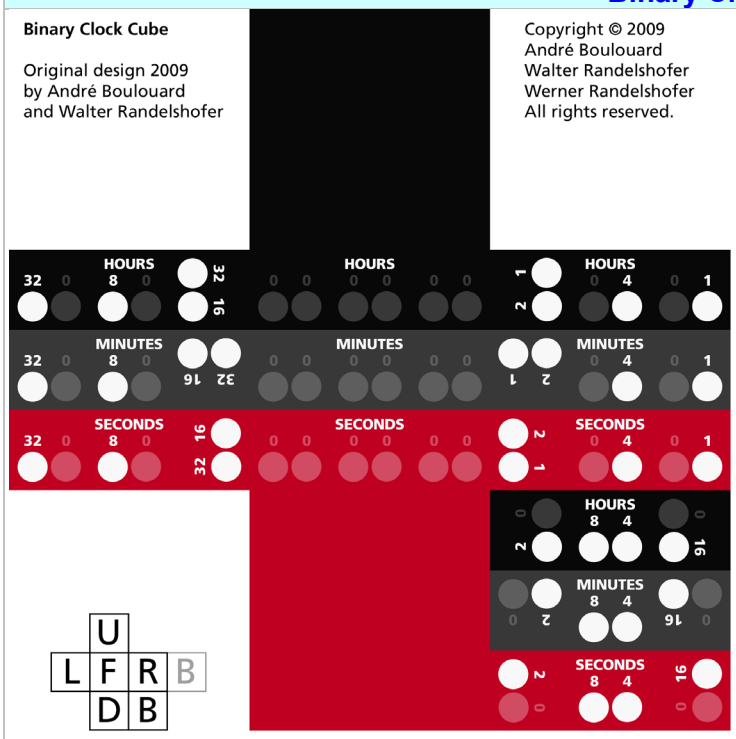
Introduction

A **Binary Clock Cube** is a 3x3x3 **Rubik's Cube** used for indicating time. A **binary clock** is a clock which displays traditional sexagesimal time in a binary format, ie. with zeros ('0') and ones ('1').

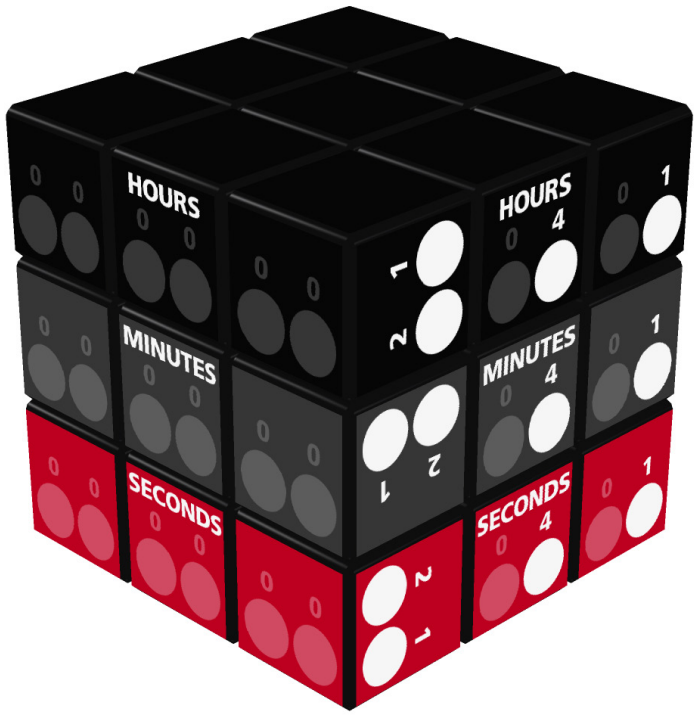
Binary Clock – Useful Links	
http://en.wikipedia.org/wiki/Binary_clock	http://en.wikipedia.org/wiki/Binary_numeral_system

There are **Virtual Cubes** that can be *virtually* rotated and twisted on a computer screen and **Real Cubes** that can only be *physically* rotated and twisted by hand. A **Texture** is laid down on a Virtual Cube whereas real **Stickers** are stuck down on a Real Cube. A Binary Clock Cube is designed by placing binary symbols and numbers, which are powers of two from 1 (2^0) up to 32 (2^5), on a texture which is then laid down on a Virtual Cube (see http://www.randelshofer.ch/ for more details). The time of the day can be displayed on a *selected* Cube Face by rotating and twisting some parts of the Cube. When this has been achieved, we say that the Cube has been *solved*. The following example shows the *initial* state of the Cube where '00:00:00' is displayed on the front face.

Binary Clock Cube



Binary Clock Cube Texture



Virtual Binary Clock Cube

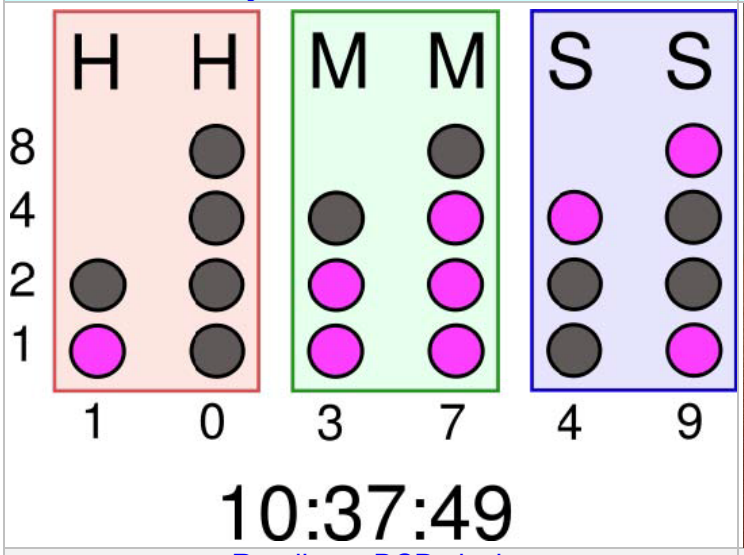
Design Features

Binary number '0' is represented on the cube by an unlit (gray) dot whereas binary number '1' is represented by a lighted dot. Numbers which are integer powers of 2 have been inserted just above the dots to ease the reading of time. Hours, minutes and seconds can then be calculated by adding numbers located above *lighted* dots.

The cube can be used in 2 display modes:

1- Mode A (True Binary Clock): Time from 00:00:00 up to 63:59:59 in 1 second steps
2- Mode B (Binary Adder): Sum of 2 binary numbers from 0 up to 63, where HOURS and MINUTES are operands and SECONDS is the sum of the 2 operands

Binary Clock Cube – Examples

Binary Coded Decimal Clock	True Binary Wristwatch
	
Reading a BCD clock	Time Technology's Samui Moon true binary wristwatch

Binary Clock Cube – Synthesized Algorithms

Binary Clock Cube – Synthesized Algorithms	
10:10:20	**20:40:10**
	
10:10:20	CU' B D' R D2 L B D2 U' B U L2 D' U B' U' D R' B2 R2 B' R' B D B' D' B L B' L'
20:40:10	CU' U2 R D B R2 U' B2 U D2 R' U B2 U' R D U' B U B2 D' R' B2 R L B2 L'

Binary Clock Cube – Design

Top Layer Layout: Hours

- 2 **T**op **L**eft corners: [0|0, 32|16, blank], [32|0, 0|16, blank]
- 4 **T**op **C**enter edges: [0|0, blank], [0|4, blank] , [8|0, blank] , [8|4, blank]
- 2 **T**op **R**ight corners: [0|0, 2|1, blank], [0|1, 2|0, blank]

Middle Layer Layout: Minutes

- 2 **M**iddle **L**eft edges: [0|0, 32|16], [32|0, 0|16]
- 4 **M**iddle **C**enters: [0|0], [0|4], [8|0], [8|4]
- 2 **M**iddle **R**ight edges:[0|0, 2|1], [0|1, 2|0]

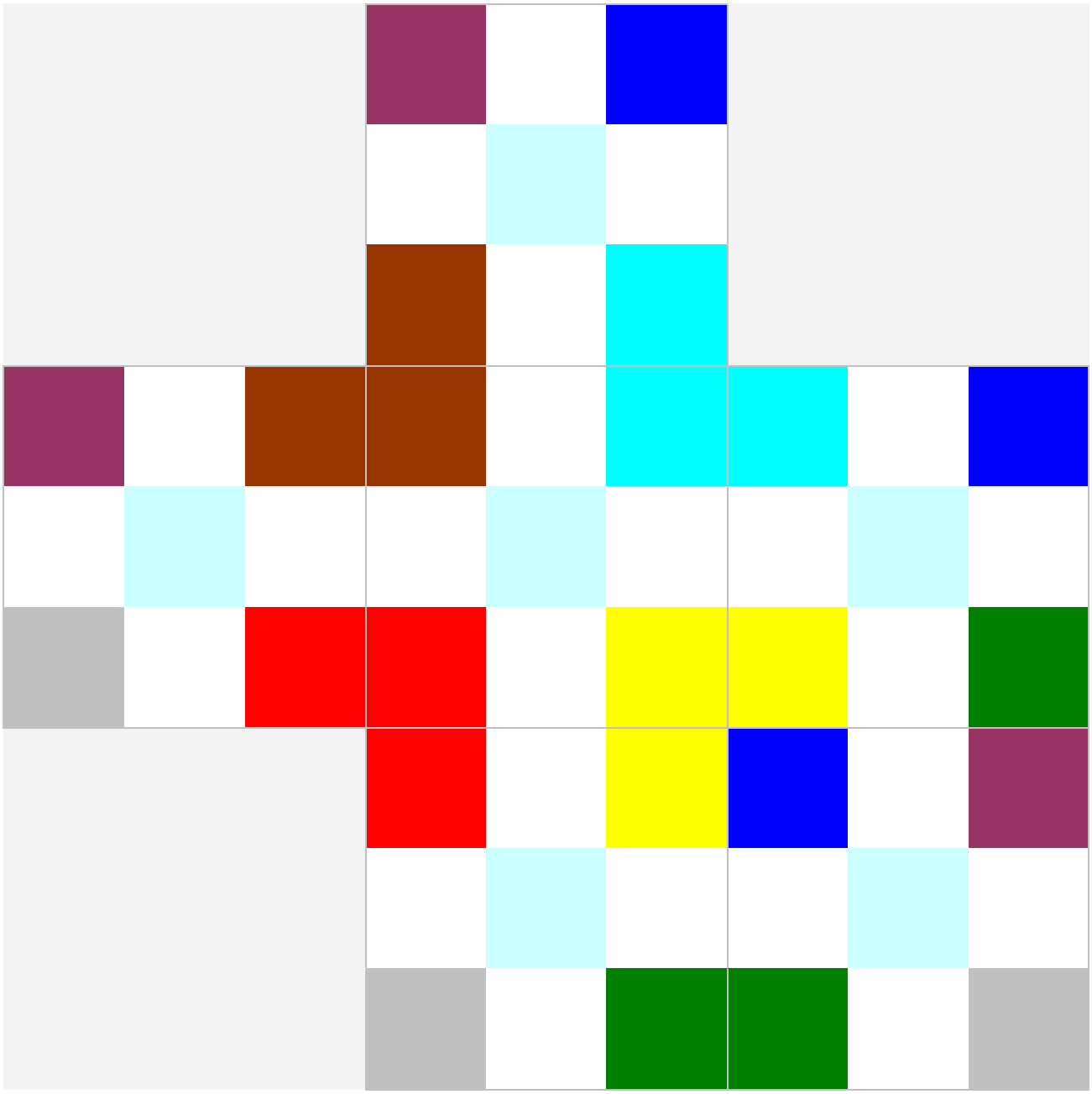
Bottom Layer Layout: Seconds

- 2 **B**ottom **L**eft corners: [0|0, 32|16, blank], [32|0, 0|16, blank]
- 4 **B**ottom **C**enter edges: [0|0, blank], [0|4, blank] , [8|0, blank] , [8|4, blank]
- 2 **B**ottom **R**ight corners: [0|0, 2|1, blank], [0|1, 2|0, blank]

Binary Clock Cube – Layout Table		
Top **L**eft – Corner cubes	**T**op **C**enter – Edge cube	**T**op **R**ight – Corner cubes
0|0, 32|16, 32|0, 0|16	0|0, 0|4, 8|0, 8|4	0|0, 2|1, 0|1, 2|0
Middle **L**eft – Edge cubes	**M**iddle **C**enter – Center cubes	**M**iddle **R**ight – Edge cubes
0|0, 32|16, 32|0, 0|16	0|0, 0|4, 8|0, 8|4	0|0, 2|1, 0|1, 2|0
Bottom **L**eft – Corner cubes	**B**ottom **C**enter – Edge cubes	**B**ottom **R**ight – Corner cubes
0|0, 32|16, 32|0, 0|16	0|0, 0|4, 8|0, 8|4	0|0, 2|1, 0|1, 2|0

Corner Cubes Final Check

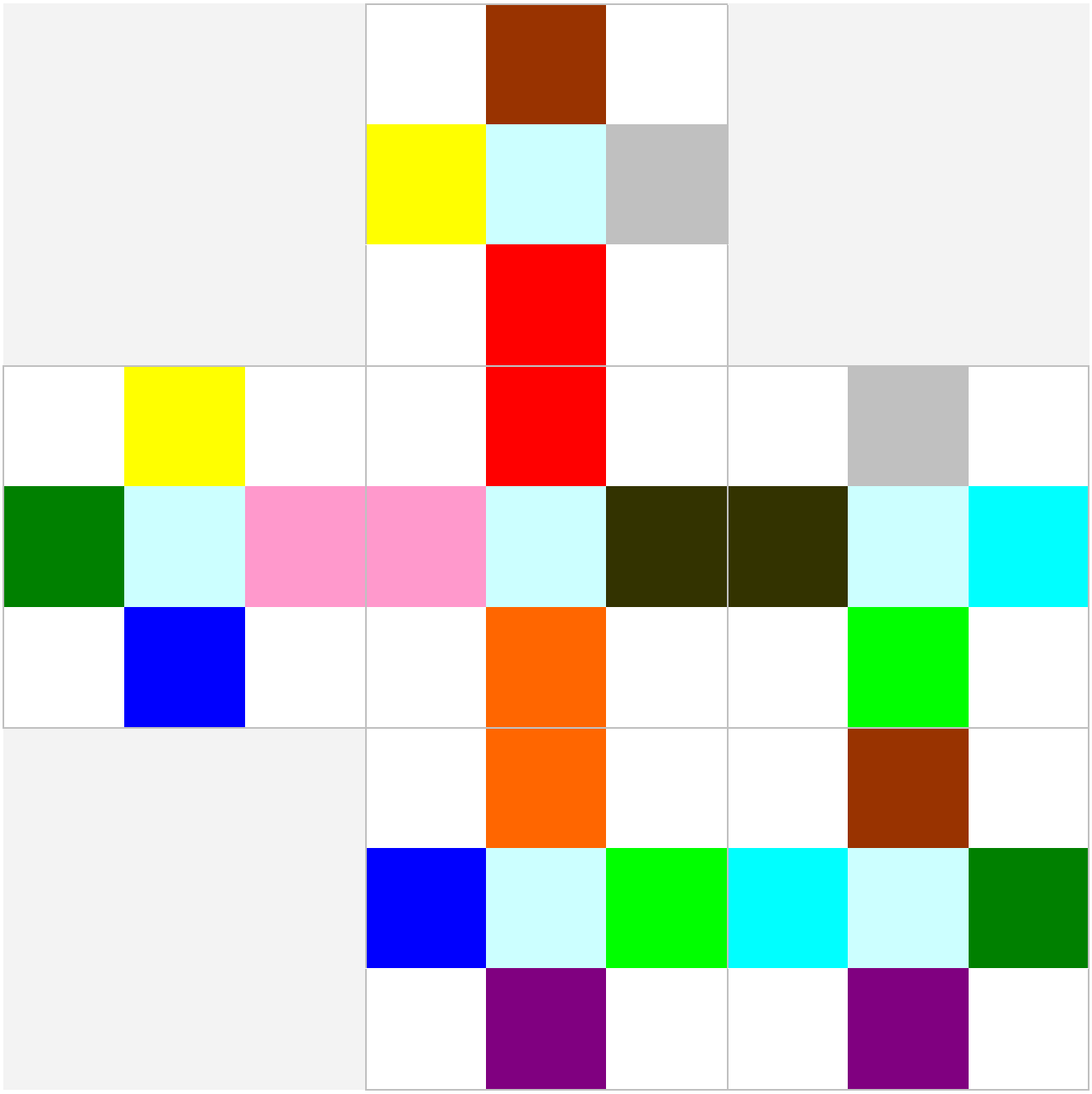
There are 8 Corner Cubes and 3 faces per Corner Cube. In the diagram below, each Corner Cube is displayed in 8 different colors and with the same color applied to each of its 3 faces. This diagram can be used as a convenient *visual aid* to check Design Rules (DRC).

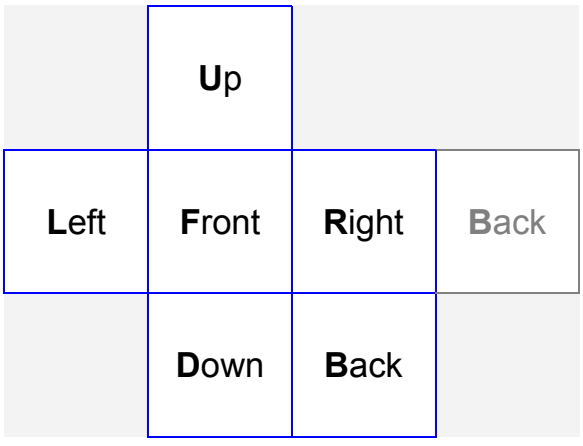


	Up		
Left	**F**ront	**R**ight	**B**ack
	Down	**B**ack	

Edge Cubes Final Check

There are 12 Edge Cubes and 2 faces per Edge Cube. In the diagram below, each Edge Cube is displayed in 12 different colors and with the same color applied to each of its 2 faces. This diagram can be used as a convenient *visual aid* to check Design Rules (DRC).





Texture Template

This is a texture template that can be printed out and used for writing down numbers and letters by hand *prior to* texture design. All is needed are pencil, rubber…and time.