V-Cube 6

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V-Cube 6 in package.

The **V-Cube 6** is the 6×6×6 version of Rubik's Cube. Unlike the original puzzle (but like the 4×4×4 cube), it has no fixed facets: the center facets (16 per face) are free to move to different positions. It was invented by Panagiotis Verdes and is produced by his company, Verdes Innovations SA.

Methods for solving the 3×3×3 cube work for the edges and corners of the 6×6×6 cube, as long as one has correctly identified the relative positions of the colors — since the center facets can no longer be used for identification.

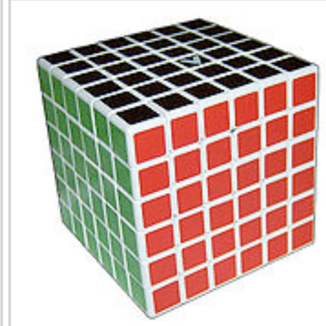
Contents

Mechanics

V-Cube 6 in a scrambled state

The puzzle consists of the 152 unique miniature cubes ("cubies") on the surface. There are also 60 movable pieces entirely hidden within the interior of the cube, as well as six fixed pieces attached to the central "spider" frame. The puzzle uses same mechanism as the V-Cube 7, except that on the latter the hidden pieces are made visible.[1]. The center 16 cubes of each face are merely single square façades hooked into the hidden internal mechanism. This is the largest change to the 3×3×3 cube, because the center pieces can move in relation to each other, unlike the fixed centers on the original.

There are 48 edge pieces which show two colored sides each, and eight corner pieces which show three colors. Each piece (or quad of edge pieces) shows a unique color combination, but not all combinations are present (for example, there is no edge piece with both black and yellow sides, since black and yellow are on opposite sides of the solved Cube). The location of these cubes relative to one another can be altered by twisting the outer layers of the Cube 90°, 180° or 270°, but the location of the colored sides relative to one another in the completed state of the puzzle cannot be altered: it is fixed by the distribution of color combinations on edge and corner pieces.



V-Cube 6 in solved state.

Currently, the V-Cube 6 is produced with white plastic as a base, with red opposite orange, blue opposite green, and yellow opposite black. One black center piece is branded with the letter **V**. Verdes also recently began selling a version with black plastic and a white face, with the other colors remaining the same.

Unlike the rounded V-Cube 7 produced by the same company, the V-Cube 6 has flat sides. However, the outermost pieces are slightly wider than those in the center. The center four rows are approximately 10 mm wide, whereas the outer two are approximately 13 mm wide. This subtle change allows the use of a thicker stalk to hold the corner pieces to the internal mechanism, thus making the puzzle more durable.

Permutations

There are 8 corner cubelets, 48 edge cubelets and 96 center cubelets.

The V-Cube 6 is roughly the same size as the official Professor's Cube.

Any permutation of the corner cubelets is possible, including odd permutations. Seven of the corner cubelets can be independently rotated, and the eighth cubelet's orientation depends on the other seven, giving $8! \times 3^7$ combinations.

There are 96 center cubelets, consisting of four sets of 24 pieces each. Center pieces from one set cannot be exchanged with those from another set. Each set can be arranged in 24! different ways. Assuming that the four center cubelets of each color in each set are indistinguishable, the number of permutations is reduced to $24!/(4!^6)$ arrangements, all of which are possible, independently of the corner cubelets. The reducing factor comes from the fact that there are 4! ways to arrange the four pieces of a given color. This is raised to the sixth power because there are six colors. The total number of center permutations is this figure raised to the fourth power, $24!^4/(4!^{24})$. An odd permutation of the corner cubelets implies an odd permutation of the center cubelets, and vice versa; however, even and odd permutations are indistinguishable because of identically colored center cubelets.

There are 48 edge pieces, consisting of 24 inner and 24 outer edge cubelets. These cannot be flipped (because the internal shape of the pieces is asymmetrical), nor can an inner edge exchange places with an outer edge. The four edge cubelets in each matching quad are distinguishable, since the colors on a cubelet are reversed relative to the other. Any permutation of the edge cubelets in each set is possible, including odd permutations, giving 24! arrangements for each set or $24!^2$ total, regardless of the orientation of the corner or center cubelets.

Assuming the cube does not have a fixed orientation in space, and that the permutations resulting from rotating the cube without twisting the cube are considered identical, the number of permutations is reduced by a factor of 24. This is derived from the fact that all 24 possible positions and orientations of the first corner are equivalent because of the lack of face centers. This factor does not appear when calculating the permutations of N×N×N cubes where N is odd, since those puzzles have fixed centers which identify the cube's spatial orientation.

This gives a total number of permutations of

$$\frac{8! \times 3^7 \times 24!^6}{4!^{24} \times 24} \approx 1.57 \times 10^{116}$$

The entire number is 157 152 858 401 024 063 281 013 959 519 483 771 508 510 790 313 968 742 344 694 684 829 502 629 887 168 573 442 107 637 760 000 000 000 000 000 000 000 000 (around 157 novemdecillion on the long scale or 157 septentrigintillion on the short scale).

However, one of the black center pieces is marked with a **V**, which distinguishes it from the other three in its set. This increases the number of patterns by a factor of four to 6.29×10^{116}, although any of the four possible positions for this piece could be regarded as correct.

Solutions


Disassembled.

There are a number of methods that can be used to solve a V-Cube 6. The layer by layer method that is often used for the 3×3×3 cube can be used on the V-Cube 6. One method is to first group the center pieces of common colors together, then to match up edges that show the same two colors. Once this is done, turning only the outer layers of the cube allows it to be solved like a 3×3×3 cube. However, certain positions that cannot be solved on a standard 3×3×3 cube may be reached. For instance, a single pair or quad of edges may be inverted, or the cube may appear to have an odd permutation (that is, two pieces must be swapped, which is not possible on the 3×3×3 cube). These situations are known as parity errors, and require special algorithms to be solved.

Such situations arise because mathematically, the possible permutations of the edges depend on the permutation of the face centers. Each cube face in the solved state has four sets of face centers that are visually identical (the four inner centers, the four corner outer centers, and the other eight outer centers), but mathematically distinct. As a result, if a pair of visually identical face centers in any of these four groups are swapped when grouping the center pieces together, the parity of the edge pieces is reversed, leading to such apparently impossible positions. The algorithms for solving these parity errors work by exchanging a pair of visually-identical face center pieces (which also exchanges a pair of edge pieces), thereby reversing the parity of the edges, bringing them into a solvable state.

Another similar approach to solving this cube is to first pair the edges, and then the centers. This, too, is vulnerable to the parity errors described above.

Some methods are designed to avoid the parity errors described above. For instance, solving the corners and edges first and the centers last would avoid such parity errors. Once the rest of the cube is solved, any permutation of the center pieces can be solved. Note that it is possible to apparently exchange a pair of face centers by cycling 3 face centers, two of which are visually identical.

Records

As of August 2008, this event has not been included in official competition, so no verifiable records exist for it. The earliest point the event may possibly become official is 2009, when new regulations may come into effect. Unofficially, Michael Gottlieb solved the V-Cube 6 in 3 minutes 20.82 seconds.

Verdes Innovations announced a competition, including the 5×5×5 (all brands), 6×6×6 and 7×7×7. The event was held October 26th in Essen, Germany. [2]

See also

- Pocket Cube (2×2×2)
- Rubik's Cube (3×3×3)
- Rubik's Revenge (4×4×4)
- Professor's Cube (5×5×5)
- V-Cube 7 - (7×7×7)
- Combination puzzles

References

Notes

1. ^ United States Patent 20070057455 (http://www.freepatentsonline.com/20070057455.html)
2. ^ V-Cube Competition flyer (http://www.v-cubes.com/pdf/V-CUBES_COMPETITION.pc PDF (149 KB)

Further reading

- Rubik's Revenge: The Simplest Solution (Book) by William L. Mason

External links

- Verdes Innovations SA (http://www.v-cubes.com/index.php) Official site.
- Frank Morris takes on the V-Cube 6 (http://www.youtube.com/watch?v=bbIFVHR_sS8)
- Program Rubik's Cube 3D Unlimited size (http://kubrub.googlepages.com/rubikscube)