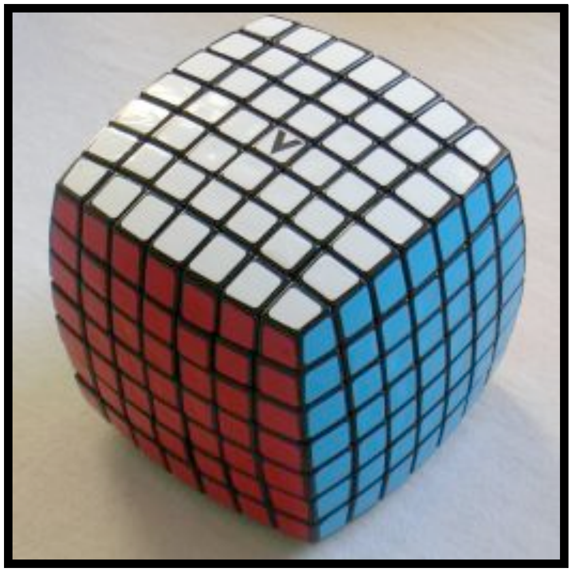
7x7x7 V-Cube



This puzzle is a cube which is built from smaller cubes, 7 to an edge, i.e. a 7×7×7 cube. Like a Rubik's Cube each slice can rotate, which rearranges the small cubes on the surface of the puzzle. The six sides of the cube are coloured, so every corner piece shows three colours, every edge piece shows 2 colours, and every face centre only one.

The V-Cubes worldwide patent was granted to inventor Panagiotis Verdes on 2 December 2012, WO 2004 103497.

The number of positions:

There are 8 corner pieces with 3 orientations each, 12 middle edge pieces with 2 orientations each, 24 inner edge pieces and 24 outer edge pieces apparently with 2 orientations each. There are 6 types of centre pieces, 24 pieces of each type. This gives a maximum of $8!\cdot 12!\cdot 24!^8\cdot 3^8\cdot 2^{60}$ positions. This limit is not reached because:

- The total twist of the corners is fixed (3)
- The total flip of the middle edges is fixed (2)
- The permutation of the corners and middle edges is even (2)
- The inner/outer edge orientation is dependent on its position, i.e. inner and outer edges cannot actually be flipped (2^{48})
- There are indistinguishable face centres ($4!^{6\cdot 6}$)

This leaves $8!\cdot 12!\cdot 24!^8\cdot 3^7\cdot 2^{10} / 4!^{36}$ = 19,500,551,183, 731,307,835,329,126, 754,019,748,794,904, 992,692,043,434,567, 152,132,912,323,232, 706,135,469,180,065, 278,712,755,853,360, 682,328,551,719,137, 311,299,993,600,000, 000,000,000,000,000, 000,000,000,000,000 = $1.95\cdot 10^{160}$ positions.

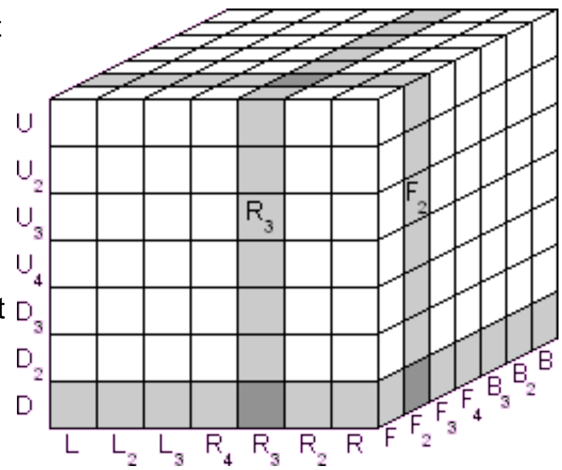
Links to other useful pages:

V-Cubes homepage has an on-line shop, and a solution method like this one.

Like the normal cube, there are several types of solution. Here I will only give the 'Edge-Matching' solution method.

Notation:

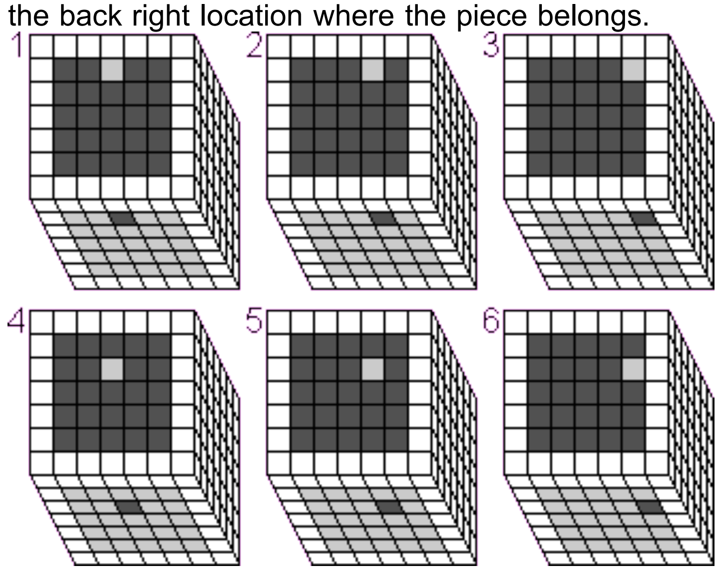
Let the faces be denoted by the letters L, R, F, B, U and D (Left, Right Front, Back, Up and Down). Clockwise quarter turns of a face layer are denoted by the appropriate letter, anti-clockwise quarter turns by the letter with an apostrophe (i.e. L', R', F', B', U' or D'). Half turns are denoted by the letter followed by a 2 (i.e. L2, R2, F2, B2, U2 or D2). The above is the same notation as for the 3×3×3 cube. An internal slice will be denoted by adding a subscript 2, 3 or 4. So F_2 is a clockwise turn of the slice immediately behind the Front face, and F_3' is an anti-clockwise turn of the slice immediately behind that. Note that these denote a slice only, so such a move will not disturb the corners of the cube.
The location of any piece can be denoted by listing the three faces/slices it lies in.



Solution

Phase 1: Solve centres
The method below solves the U centres without disturbing any already solved faces. Simply repeat this for each of the faces.

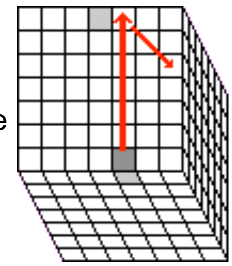
a. Find any centre piece edge that belongs on the U face. Hold the cube so that it lies on the F or D face.
b. If the piece is in the front face, turn F to put the piece at the top right, i.e. in the U_2 or U_3 layer, and the R_2, R_3, or R_4 slice. If it is in the bottom face, turn D to put the piece at the front right, i.e. in the F_2 or F_3 slice, and the R_2, R_3, or R_4 slice.
c. Turn the U face so that there is an incorrect piece at the back right location where the piece belongs.
d. Do one of the following move sequences to insert the centre piece:
1. From F U_2 R_4 to U B_2 R_4: Do R_4 U' L_2' U R_4' U' L_2
2. From F U_2 R_3 to U B_2 R_3: Do R_3 U' L_2' U R_3' U' L_2
3. From F U_2 R_2 to U B_2 R_2: Do R_2 U' L_2' U R_2' U' L_2
4. From F U_3 R_4 to U B_3 R_4: Do R_4 U' L_3' U R_4' U' L_3
5. From F U_3 R_3 to U B_3 R_3: Do R_3 U' L_3' U R_3' U' L_3
6. From F U_3 R_2 to U B_3 R_2: Do R_2 U' L_3' U R_2' U' L_3
7. From D F_2 R_4 to U B_2 R_4: Do $R_4$2 U' $L_2$2 U $R_4$2 U' $L_2$2
8. From D F_2 R_3 to U B_2 R_3: Do $R_3$2 U' $L_2$2 U $R_3$2 U' $L_2$2



9. From D F_2 R_2 to U B_2 R_2: Do $R_2$2 U' $L_2$2 U $R_2$2 U' $L_2$2
10. From D F_3 R_4 to U B_3 R_4: Do $R_4$2 U' $L_3$2 U $R_4$2 U' $L_3$2
11. From D F_3 R_3 to U B_3 R_3: Do $R_3$2 U' $L_3$2 U $R_3$2 U' $L_3$2
12. From D F_3 R_2 to U B_3 R_2: Do $R_2$2 U' $L_3$2 U $R_2$2 U' $L_3$2

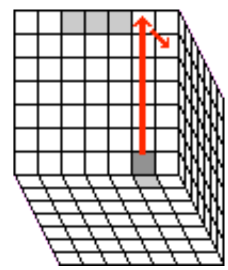
e. Repeat a-d until all 24 centre pieces in the U face are correct.
f. Repeat a-e for each of the faces.

Phase 2: Match up the inner edges.
In this phase the inner edge pieces are matched up to form matching pairs.



a. Find any inner edge piece that is not yet matched up with its middle edge piece. Hold the cube so that this piece lies at the U F R_3 location.
b. Find the matching middle edge piece. Use any face moves to bring it to the U B location.
c. Check that the middle edge piece shows a different colour on the U face than the inner edge piece. If not, then flip over the middle edge piece by doing B' U R' U'.
d. Find any unmatched inner edge piece and put it at the U R B_3 location, without disturbing the other two pieces. If there is no other unmatched inner edge, then do U2 R_3 U2 R_3 U2 R_3 U2 R_3 U2 R_3 to make some new unmatched inner edge pairs and try again.
e. Do R_3 B'RB R_3'.
f. Repeat a-d until all inner edges are matched up with the middle edges.

Phase 3: Match up the outer edges.
In this phase the outer edge pieces are matched up to the middle/inner edge triplets.



a. Find any outer edge that is not yet matched up with its middle triplet. Hold the cube so that this piece lies at the U F R_2 location.
b. Find the matching edge triplet. Use any face moves to bring them to the U B location.
c. Check that the triplet shows a different colour on the U face than the outer edge piece. If not, then flip over the triplet by doing B' U R' U'.
d. Find any other unmatched outer edge piece and put it at the U R B_2 location without disturbing the other pieces. If there is no other unmatched pair, then do U2 R_2 U2 R_2 U2 R_2 U2 R_2 U2 R_2 to make some new unmatched outer edges and try again.
e. Do R_2 B'RB R_2'
f. Repeat a-e until all edges lie in matching edge quadruplets.

Phase 4: Solve the cube.

a. Solve the cube by turning outer faces only, using any method for the 3×3×3 cube. This is always possible.

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