

## How to: Robot operations

MindCuber can solve a standard 3x3x3 Rubik's Cube. It works best with cubes with the standard colors, red, orange, green, blue, yellow and white but will work with some other combinations. The cube must be very smooth and easy to turn.

Select and run the "MindCuber" software file on the NXT. MindCuber starts by moving the "tilt arm" and then the "scan arm" as far as it can to determine where they are. The color sensor flashes red during this process to show that it is running. If there is a Rubik's Cube in the turntable, MindCuber detects this and display a message asking you to remove the cube.

When MindCuber detects that there is no cube present, it stops flashing the color sensor and displays a message asking you to insert a scrambled cube.

You must make sure that the "turntable" is correctly aligned so that its front edge is in the same direction as the frame since MindCuber is unable to do this itself. Use the left button on the NXT to rotate the turntable anti-clockwise and the right button to rotate it clockwise. Short presses will rotate by small steps for fine adjustment. A long press will continuously rotate the turntable for larger adjustments. When the motor is stopped, the turntable can rotate a little because of the gears between it and the motor. Try to rotate the turntable very gently by hand. Check that you can rotate it by the same amount each way past the correct position. The turntable usually only needs to be aligned once each time the program is started but you can adjust it at any time when MindCuber is waiting for the cube to be inserted.

Place the scrambled Rubik's Cube in the turntable. MindCuber uses the ultrasonic sensor to detect when the cube is present and starts automatically. It scans the cube a square at a time using the color sensor.

After all 6 faces of the cube have been scanned, MindCuber flashes the color sensor red while it attempts to determine the colors and then flashes it blue while it works out a solution. The software takes up to 10 seconds to calculate a solution and usually finds one of between about 40 and 45 moves.

Once MindCuber has calculated a solution, it then tilts and turns the cube to solve it. At the end the arms are moved away and the cube spins and the color sensor flashes green to indicate that it has finished. The flashing stops when you remove the cube.

The time is displayed continuously in the corner of the screen during and after the solve. MindCuber usually takes between 2 and 3 minutes for the complete solve process.

MindCuber is now ready for you to insert another scrambled cube to solve.

### ***Tips:***

Watch when the cube is tilted to make sure that it tilts over and slides back correctly every time. If it sometimes tilts back instead of sliding back, make sure that the stickers are placed in the turntable as indicated in the build instructions to help the cube slide easily. If the cube has particularly sharp edges, you may find that larger stickers help.

If MindCuber cannot work out the colors correctly, it rescans the cube automatically up to three times. If it still fails to determine the right colors, it will move the arms away, continue to flash the color sensor red and wait for you to remove the cube to try again. If there are bright or changing lights shining on MindCuber, it can make it harder to sense the colors correctly. Try moving MindCuber away from the lights.

If the scan still does not work well and you can solve one face of the Rubik's Cube yourself, you can calibrate the color sensor to match the white on the cube to help. When the red light is flashing red waiting for you to remove the cube, press the center orange button before removing the cube. MindCuber displays "Calibrate white" on the screen. Solve the white face of the cube yourself and put the cube into the turntable with the white face upwards. MindCuber will then scan just the white face and use that to calibrate the sensor so which may improve scan. This calibration will be used until you re-calibrate or restart the program.

If the cube is not the standard colors it may also prevent it from scanning correctly.