Now *That's* Smart Manufacturing!

Matthew Jaster, Senior Editor

It takes a self-proclaimed expert an hour or so to solve the puzzle in under 25 moves. A speedcuber (a hobbyist that enjoys figuring out twisty puzzles) figured it out in 4.9 seconds. For the rest of us, many gave up on the colorful, cubic conundrum and moved on to the next '80s fad.

We're talking, of course, about Erno Rubik's puzzle launched internationally in 1980. The Rubik's Cube has been involved in art installations, pop videos, Hollywood films and it even had its own Saturday morning cartoon (*Rubik, the Amazing Cube*).
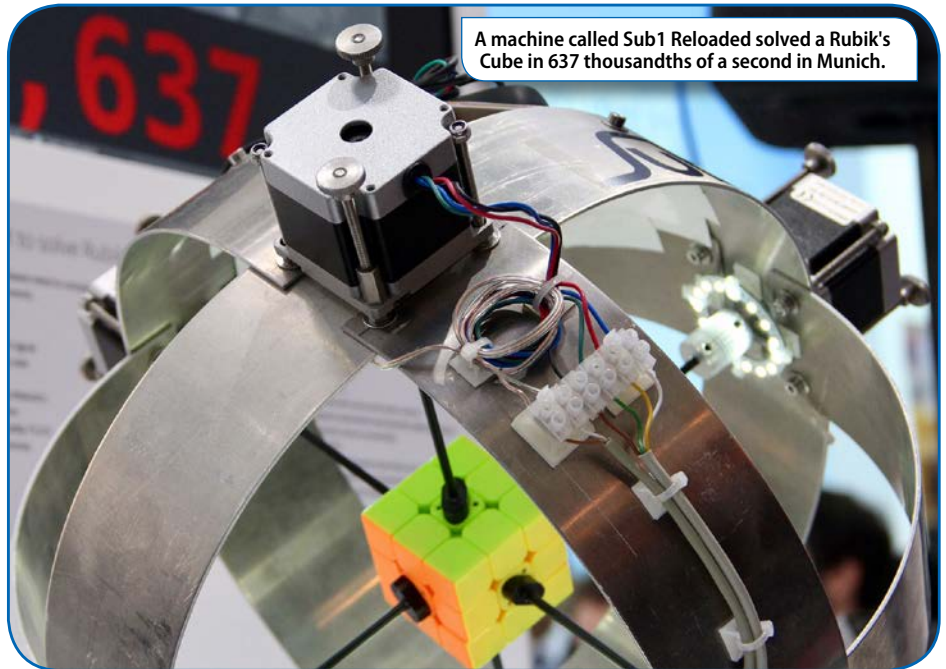
It made headlines once again in November 2016 at the Electronica Trade Fair in Munich, Germany when a machine called "Sub1 Reloaded" solved the Rubik's Cube in just 637 thousandths of a second—without doubt, the fastest time ever recorded. This was accomplished with the assistance of an AURIX microcontroller from Infineon Technologies—similar to the one used in automotive driver assistance systems.

"Obviously, the AURIX microcontroller was not designed for breaking the Rubik's Cube World Record with a machine," said Fabian Schiffer, media relations manager at Infineon Technologies AG. "But instead the set up was chosen to demonstrate the power and accuracy of the microcontroller in controlling electric motors — of which a lot can be found, for example, in automotive applications."

How was this accomplished exactly? According to Schiffer, the "Sub1 Reloaded" contains a number of other microchips. Like most devices we use every day, they link the real and digital worlds. The attempt started with the press of a button. The shutters of the sensor cameras were removed. The machine then detected the position of the elements. These had been previously scrambled, in accordance with the special requirements of the World Cube Association.

The computing chip, or the "brain" of the machine, figured out the fastest solution and transmitted the necessary commands to the power semiconductors. These "muscles" then activated six motors, one for each side of the cube, at record speed and then brought them to a halt — all within the fraction of a second (ridiculous to imagine and even more ridiculous to watch the video here: *www.youtube.com/watch?v=N1b6iPYj3YQ*.)

Every Rubik's cube can be unscrambled with just 20 movements. A variety of algorithms can be used to solve the puzzle, the most well-known of which is the Fridrich Method. But Infineon's constructor Albert Beer did not design his

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prodigy with the fewest moves in mind. Rather, he was intent on achieving the best time — he even allowed the "Sub1 Reloaded" a few extra moves to reach this goal.

"To be honest, if it was for the AURIX alone, Rubik's Cube could have been solved even faster," Schiffer added. "The machine is limited, plainly speaking, by mechanics. The multicore architecture of the microcontroller is based on up to three independent 32-bit TriCore CPUs; it has been designed to meet the highest safety standards while increasing the performance at the same time."

In addition to solving the Rubik's Cube, Infineon takes pride in supplying Tesla with more than 250 semiconductors for each Model X. The company's devices are built into the electric drivetrain, on-board charger, LED lights and motors for doors, windows, wipers and access control. They also integrated a variable-speed drive compressor in a high-end Liebherr refrigerator to make it more energy efficient.

But the real story at the trade fair was how quickly the Rubik's Cube World Record was broken.

Within a short amount of time, the video received almost 600,000 visits on YouTube. Schiffer said that the video triggered a whirlwind across social media outlets, German television stations and was even featured on the Japanese morning show *Tokudane!*

"Looking back we can state that this was the single most successful event in the history of Infineon involving magazines and newspapers, not taking into account the media coverage during IPO," Schiffer added.

The project and its rapid results, begs a far simpler question to the rest of engineering and manufacturing community:

What can *you* accomplish in 637 milliseconds? **PTE**