

# Magnetic encoders beat size and speed challenges



**Customer:**  
Micromouse Contest

**Industry:**  
Electronics, robotics

**Challenge:**  
Precise control of the wheel rotational speed, while being small in size.

**Solution:**  
RM08, the smallest magnetic encoder on the market.

## Introduction

This case study focuses on a micromouse – a small autonomous robot which runs through a designated maze. There are several annual international contests for students and robot enthusiasts challenging them to improve the intelligence and speed of their robots. Robot mice are advanced, custom built devices that are built to millimeters and grams precisely, reach speeds above 3 m/s and are able to solve the maze in just 5 to 7 seconds.

RLS magnetic encoders are used because of their miniature and lightweight design and their top performance in accuracy and high speed feedback.

## Designing a robot mouse to win

A robot mouse must find its own way through a maze, with a different and unpredictable layout between the start point in one corner and the centre point. It has several runs, with the contest scored through a combination of total time and the time for the fastest run.

“In recent years the real challenge has been the control of the robot. There are times when the difference between winning and losing is only 1/1000 of a second.”

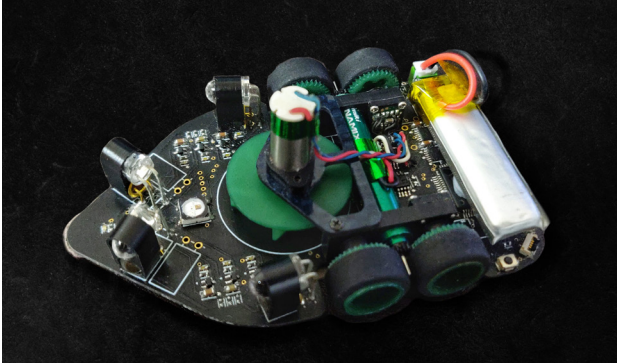
Masazuku Utsunomiya

At the top levels the contest is fierce, forcing participants to find the balance between the on-board processing power, speed and manoeuvrability, and minimising weight to the last gram.

Masakazu Utsunomiya, long-time competitor on All Japan Micromouse Contest, has been contributing to this contest for more than 13 years and has up to today built 18 micromice.

»The robot is a wheel differential vehicle and is driven by a DC motor. It has a microcontroller and sensors located on all four sides to detect walls and avoid them. It also has a gyro sensor that detects the angular velocity of the robot,« explains Utsunomiya.

Utsunomiya has designed multiple versions of a robot, improving its speed, accuracy and search algorithms through the years. Its latest addition, RLS' RM08 magnetic encoder, is precise and small (in size) thus enabling the control of the wheel's rotational speed without unnecessary additional weight.



Robot mouse with an integrated RM08 encoder for precise control of wheel rotational speed.

## Challenge

Competitors have to design the robot in a way that it finds its way from a predetermined starting position to the goal area of the maze unaided. The robot must keep track of its position, detect walls as it explores area, map out the maze, calculate the shortest route from starting to final position and detect when it has reached the goal. Robot has five runs – the fastest run is recorded as its official time. Winner of the contest is the fastest robot.

A robot mouse can use various searching algorithms, which are critical to the performance. They calculate total travel distance and number of turns as well as detect walls and final position. However, there are some typical searching algorithms used by Micromouse robots. Most of them are quite well developed and find the optimal route in just a few runs.

Utsunomiya notes that one of the most difficult challenges is not programming the robot but the control of the robot, to run the robot quickly through a narrow maze without hitting any walls. Light and small RM08 magnetic encoder helped to improve robot's size and weight, which affects also its performance enabling a robot to find the optimal way out of the maze the fastest.



Micromouse contest is one of the oldest robotic contests performed all over the world.

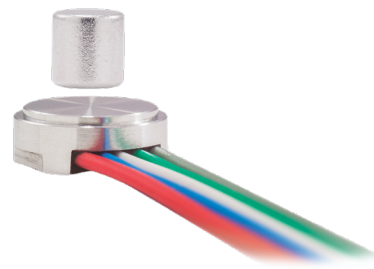


Micromouse embodies so many aspects of engineering that it is clear how it appeals to education as well as providing a possibility of using the latest technology to improve designs of the future.

## Solution

Super-small size RM08 rotary magnetic encoder is a perfect solution for space constraint applications like a robot mouse. With just 8 mm diameter encoder body the RM08 is the smallest rotary encoder on the market.

The encoder provides industry standard analogue sinusoidal, incremental, SSI and linear voltage output formats at up to 12 bit resolution. With its high-speed operation and 0.3° accuracy RM08 is a reliable position feedback solution. The encoder and magnet weigh only 2 grams which is a major benefit for robotic applications.



RM08 super-small rotary encoder with 8 mm diameter and less than 2 grams of weight brings optimum performance without compromising the robot's size and weight limitations.



### About contest Micromouse

The Micromouse Contest has been held since the 1970s and it's one of the oldest robotic contests performed all over the world. It is especially popular in Japan, USA, Singapore, India, UK and South Korea. Its main goal is to design a small autonomous robot, which can solve a 16 x 16 (or 32 x 32) maze unaided.

### About RLS

RLS d.o.o is a Renishaw associate company. RLS produce a range of robust magnetic rotary and linear motion sensors for applications such as industrial automation, metalworking, textiles, packaging, electronic chip / board production, robotics and more.

For more information visit [www.rls.si](http://www.rls.si)

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**RLS Merilna tehnika d. o. o.**  
Poslovna cona Žeje pri Komendi  
Pod vrbami 2  
SI-1218 Komenda  
Slovenia

**T** +386 1 5272100  
**F** +386 1 5272129  
**E** [mail@rls.si](mailto:mail@rls.si)  
[www.rls.si](http://www.rls.si)

For worldwide contact details, visit [www.rls.si/contact](http://www.rls.si/contact)

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