# The LEGO® MINDSTORMS® Evolution

By Jetro

Pictures by The LEGO Group

2013 marks the 15th anniversary of the first LEGO® MINDSTORMS® set, the Robotics Invention System, which featured the RCX, one of the first programmable bricks marketed by LEGO and developed in collaboration with the MIT Media LAB. However, the evolution of LEGO robotics, which came to be known under the theme name MINDSTORMS, started several years earlier. The first page in that evolution was written in 1984, and the events that led up to that moment trace back even further.

In 1980 Seymour Papert wrote the book 'MINDSTORMS: Children, Computers and Powerful Ideas' – which is where the LEGO robotics product got its name from. In this book he explored to groundbreaking concepts: children can become proficient with computers, and learning to use computers can change the way they learn in all other areas.
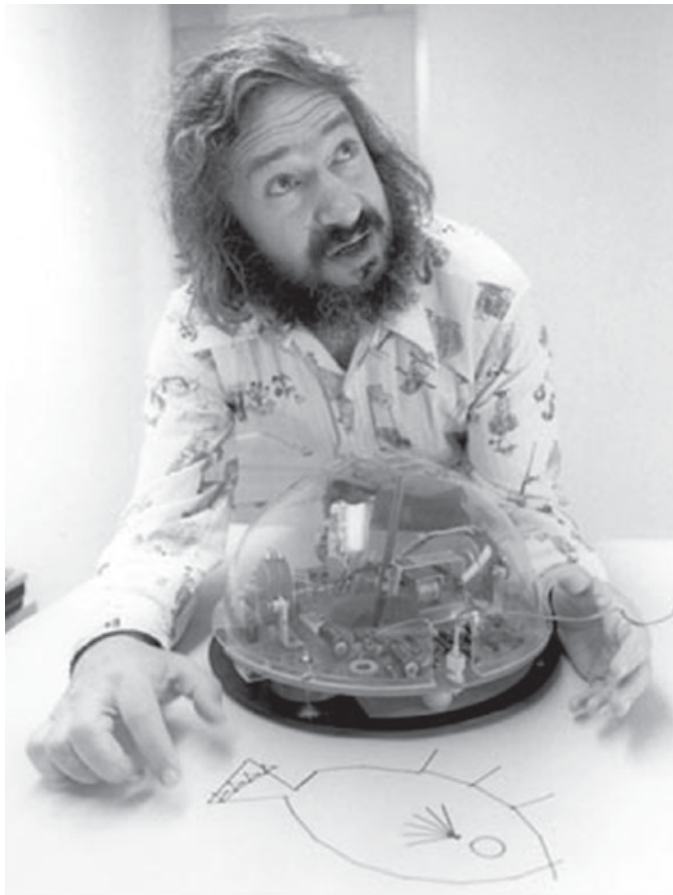
In 1984, Kjeld Kirk Kristiansen, President and, at the time, CEO of LEGO, saw a TV program in which children used the LOGO programming language, developed by Wally Feurzeig and Seymour Papert, to control the behaviour of turtle robots.

These turtles could draw complex geometrical patterns using relatively simple instructions. Kjeld was interested and asked his management to contact Seymour Papert.

The LEGO Group visited the MIT Media Lab in Boston which was founded in 1985 and the very next year the first computer-controlled LEGO products were released. The LEGO Interface A (marketed as set number 1093 and 9750) consisted of a control interface that was connected to a computer serial port and could control several 4.5V motors and sensors. The interface could be used in conjunction with LEGO Technic sets from the Dacta theme, such as technic Control 1 and 2 which featured such constructions as a robotic arm prototype or a plotter. To program these creations a special version of the LOGO computer language was developed.

The drawback of both this interface and its successor, the Control Lab Serial Interface (9751) was that the creations they controlled were attached to the computer with wires and so autonomy was limited, but as early as 1986 the product development department "LEGO Futura Boston Branch" was set up to work closely together with the MIT Media Lab and the following year this team came up with the first working prototype of a programmable brick.

More than a decade would pass before such a brick was marketed. This was due to the fact that there were still very few households that had a PC, and the cost for the components

was high. However, in 1997 LEGO® MINDSTORMS® becomes a trademark and the following year the LEGO MINDSTORMS Robotics Invention System (RIS) is launched in the USA and UK. At the core of this product is the RCX. The programming language used for this pBrick (programmable brick) was a radical departure from the text based LOGO language. The RIS software was a visual programming language in which programming blocks were stacked vertically down. A second programming option for the RCX was ROBOLAB™, a software based on National Instruments LabVIEW™ and developed for the LEGO MINDSTORMS sets for schools.

In order to promote this new and revolutionary product ROBOTour '98 Across America was organised, visiting 30 cities to draw attention to the product. At the same time the FIRST® LEGO League was launched, a partnership between the LEGO Group and FIRST (For Inspiration and Recognition of Science and Technology), with the goal to inspire and stimulate young people's interest in science and technology through engaging, hands-on and minds-on experiences. One of the models of the retail set featured a driving base with a pen holder, a clear reference to the turtle bots that inspired the LEGO Robotics effort.
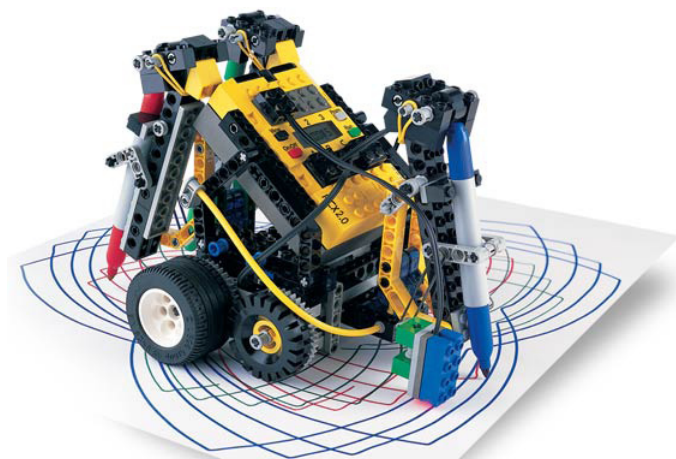
The launch was an overwhelming success, and not just for children. From August to December 1998 no fewer than 80,000 sets and to much surprise, 52% of all robotics sets of the retail version (the version that is sold in toy shops, as opposed to the version specifically marketed for schools) are registered to adults. Within weeks a complete inventory of the electronic components used in the RCX as well as reversed engineered software solutions for the pBrick are proposed on the internet. LEGO is at first startled and uncertain whether to prosecute this apparent breach of its intellectual ownership of the product, but on second thought it decides to embrace the initiatives and actively collaborates with some of the AFOL pioneers in this field.

This collaboration led to some important involvement of AFOLs in the development of the second generation of MINDSTORMS robotics, the NXT, which was launched in 2006. In addition to using more advanced technology for existing functions in this pBrick, new technologies were incorporated, including Bluetooth and USB communication (substituting the earlier IR protocol), an additional sensor port, new sensors and the inclusion of rotation sensors in the motors.

The software that comes with the NXT is again powered by National Instruments LabVIEW, both in the retail and in the educational versions. Specific and more advanced sensors, compatible with the NXT, are produced by HiTechnic and later on by other manufacturers as well. The educational possibilities of the NXT set are expanded with several add-on sets, including the Green City Challenge Activity Pack which gives students the opportunity to solve real-world problems dealing with energy by building such elements as a power plant, a wind turbine and a dam.

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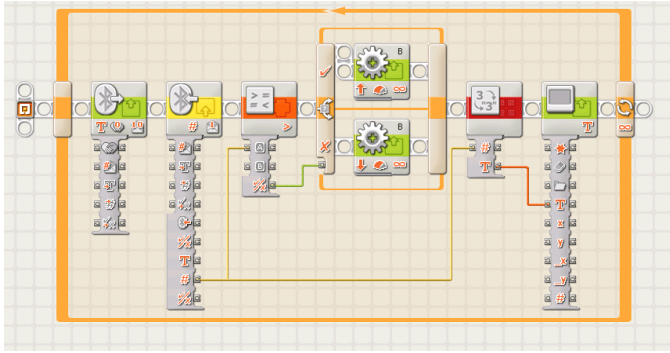
2013 marks the release of the 3rd generation in the MINDSTORMS® evolution, the EV3. Once again significant improvements have been made in the hardware, including a 4th motor port, the ability to expand memory with a MicroSD card, new sensors, a new small motor with encoder. The software for programming this new generation of MINDSTORMS is once again based on National Instruments LabVIEW but the firmware is basically a Linux OS, making this the most hackable MINDSTORMS set to date. But most importantly, it continues to be a tool that empowers children to become proficient in robotics and learn many other things in a hands-on and minds-on way.
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