Mathematikon: A Mathematical Shopping Center

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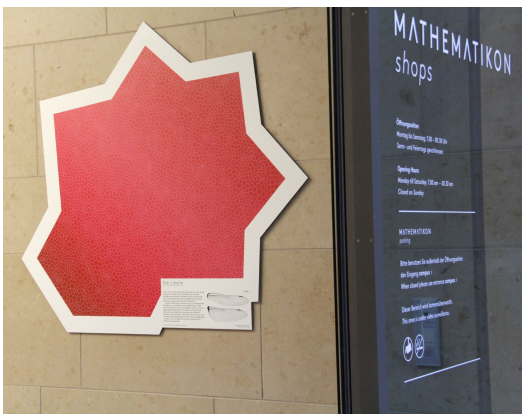
Abstract

We describe the permanent integration of mathematical content into a shopping center in Heidelberg, Germany. Main features are a mathematical image gallery, conveyor belt designs, a multi touch screen station, riddles in the bathroom, and at the bakery, classic quotes, as well as a temporary shop window display.

Introduction

On February 18, 2016, the Mathematikon *shops* opened in Heidelberg, Germany. The shopping center is integrated in a building complex called Mathematikon, which had been planned and built over several years by the Mathematikon Heidelberg GmbH (n. S. R.) & Co. KG. Three buildings share an area of 18.000 square meters and provide offices for the departments of mathematics, computer sciences and other institutes, as well as an underground parking garage and a public shopping center. Emphasis was put on the connection between mathematics, architecture and art: On the Klaus Tschira Platz between the A and B buildings of the Mathematikon you will find three large mathematical stainless steel sculptures by Dutch mathematician and artist Koos Verhoeff [1], and on a wall of the lower court of building A there are head reliefs of mathematicians, who have been awarded the Fields Medal, one of the highest honors a mathematician can receive.

In December 2015, IMAGINARY [2] took on the challenge to create and design modern mathematical content, which could be integrated into the shopping center. The aim of the mathematical installations is to encourage people to think about mathematics during everyday errands, to amaze and to activate thought-provoking impulses. We want to reach mathematicians as well as people with little or no contact to mathematics and provide a special shopping experience for kids and adults alike. Together with mathematicians and artists from all over the world—precisely from 14 countries—we created a unique composition of art gallery, shopping center and science center.

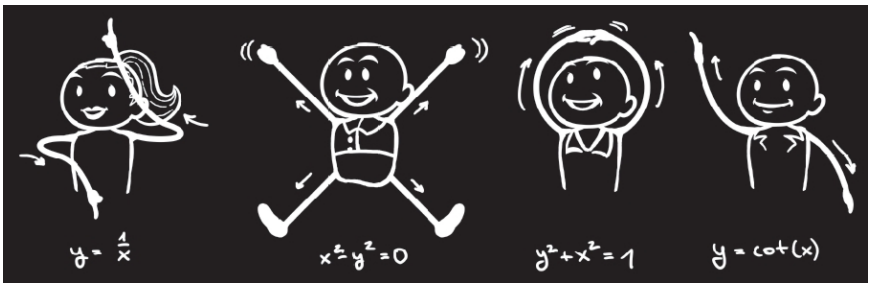


The mathematical image gallery

When you enter the Mathematikon shops, either through one of the three main entrances or via the underground parking garage, the mathematical experience begins. Twelve large format images are presented together with easy-to-read descriptions. They provide an insight into different fields of mathematics: An algebraic apple is described by a simple formula and the seemingly irregular pattern of a wing of a dragonfly is being revealed as a mathematical diagram (Voronoi diagram). Other topics include knots, the butterfly effect, fractals, quasicrystals, and much more. All images are also pieces of art and are available under a creative commons license.

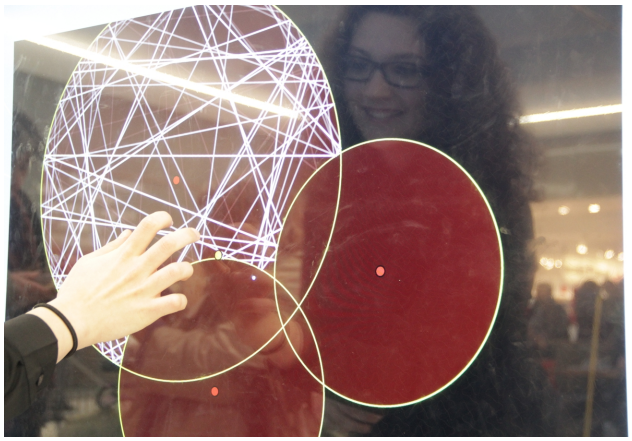
The mathematical design of the conveyor belts

For the supermarket and the drug-store of the shopping center, we created four different mathematical designs for the conveyor belts, so waiting at the cashiers can be fun and entertaining. Customers are invited to playfully think about classic and modern mathematics and get inspired to do experiments with the products or even to dance. The four different topics are tessellations, platonic solids, functions and math dance.



At the tessellation belt, customers are invited to use oranges, juice cartons, bottles, pieces of butter or any other items to find dense packings. Here, a pentagon is depicted, which can be used to tile the plane. It was discovered in 2015 [3]. We also produced a brochure for the employed cashiers, so they can learn more about the math behind all four conveyor belt designs and can answer questions.

The multi touch screen station



The highlight of the mathematical content in terms of popularity as well as state of the art technology is the 84 inch multi touch screen station. It is mounted vertically in the central hall of the shopping mall. Altogether

10 interactive math games based on the Cinderella applets [4] by Jürgen Richter-Gebert are offered, two of them can be explored at the same time; at a height for adults and children. You can simulate a fish swarm, draw ornaments, manoeuvre cars out of an overcrowded parking lot, operate a double pendulum, and much more. It is suitable for all ages and a great family attraction.

More mathematics

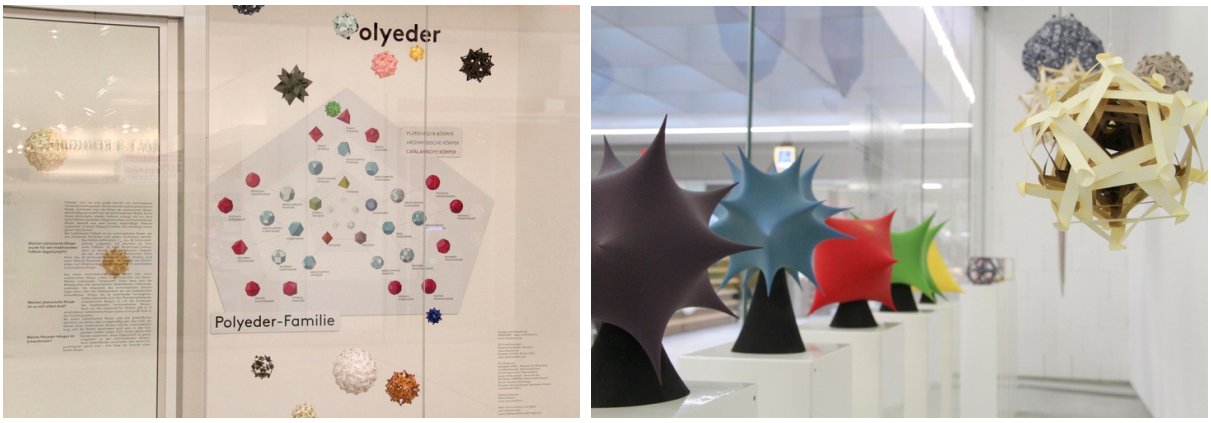
Integrated in the bathroom mirrors are screens, which display 25 short riddles. The technique hides the screens, so only the writing can be seen. After a countdown, the solution is given, which is mostly just one word or a number. The riddles are of varying difficulty and cover different areas of mathematics. Other more complex riddles will be printed onto the paper bags of the malls bakery. Customers purchase bread and pastries and will find mathematical questions on the bags.

Two classic mathematical quotes by Gauss and Galileo are displayed on the glass walls near the elevators to be viewed from almost any angle in the public area of the shopping center. The quotes intend to be thought provoking and emphasize the central and important role of mathematics.

Shop windows of an unoccupied shop unit were used to temporarily display a combination of math and art. Starting with the general concept of polyhedra, we introduce some basic background information like the Euler characteristic, nets of polyhedra and more. We also present the Platonic solids, as well as the method of elevation, first described by Luca Pacioli and Leonardo da Vinci [5]. Unique paper models of elevated polyhedra by the Dutch artist Rinus Roelofs [6] are displayed in many shapes, colors and sizes. An intuitive diagram of polyhedral relations by Allison Chen helps to understand the concept of duality and introduces Archemedian and Catalan solids. The shop window display combines large format 2D-prints of the platonic solids and diagrams, 3D-printed models, as well as paper models. Detailed descriptions and explanations are given in texts printed onto the window glass.

Conclusion

The idea of promoting mathematics at a shopping center is not new. In the early 1990s Simon Fraser University (Canada) started a project to show math in shopping centers [7]. One of the IMAGINARY exhibitions was shown in 2008 at the shopping center at the train station in Potsdam, Germany. However, the Math-



ematikon project was unique in the way math was integrated into the shopping center. Mathematics is embedded in its concept, it is not a separate installation or event. It can be found in many corners and is part of the center's functionality (i.e. the conveyor belt, the bathroom mirror, or the bakery bag). The challenge was to find a technically appealing and surprising form of integration. Design played a major role to compete against the supermarket lights and colours. Since the installation is permanent, we had to put a special focus on maintenance-free and robust exhibits. We implemented an auto-start, auto-shutdown and self-monitoring functionality in the touch screen station and prepared the mirror displays to run constantly for 24 hours. The images are mounted and produced in a safe way, i.e. very robust and with soft corners. In the first 3 months everything has been running smoothly. This installation differs from a math museum installation, since the general public has direct exposure and there is no technical staff available. The core conclusion is that to reach a wide audience, shopping centers are ideal places. The ideas and contents for the Mathematikon are all available on a creative commons license, so we hope to equip further shopping centers with math art in the future.

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