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Subject Area	Wireless Communications
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Over-the-Air Configurable Floating Pool Lights
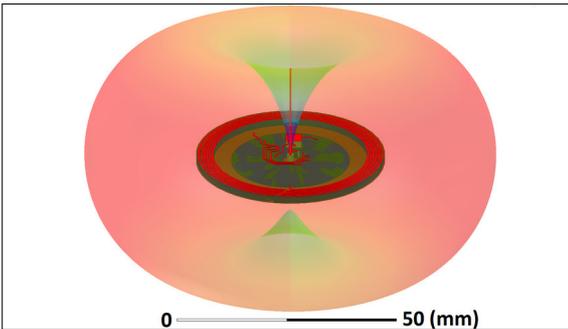
Simulated 3D antenna radiation pattern of the second prototype.
Own presentment

Communication range measured over open water.
Created with geo.admin. https://s.geo.admin.ch/8625f84901

Introduction: Wirelessly configurable lights are currently relatively expensive. Ping-pong ball-sized light sources could be used as decoration floating in a pool. Since the pool balls must be watertight, they have to feature wireless charging of a small battery. In addition, a two-way wireless communication link between a master and multiple pool balls is required. All functionalities should be implemented while keeping scalability as high as possible. This includes low production cost and a large number of simultaneously configurable devices.

Approach / Technology: The nRF52810 by Nordic Semiconductor, a 2.4 GHz radio combined with a microcontroller on a single chip, turned out to be the best-suited solution to fulfil all specifications. Nordic Semiconductor offers a proprietary radio protocol, named Enhanced ShockBurst (ESB), which is well-suited for fast and streamlined applications. In order to reduce costs, the entire circuitry has been optimized to work with few and inexpensive parts. In addition, the wireless charging feature is provided via a printed coil on the custom-made PCB. Furthermore, a simple straight wire serves as RF antenna.

Result: The first prototype, which runs on non-rechargeable AAA batteries, serves as a proof of concept for the essential functions, such as wireless communications, the lighting and the watertight housing. The second prototype improves all the existing features of the first prototype. It is powered by a 500 mAh LiPo battery, which allows a nominal runtime of 7 hours and can be recharged wirelessly. Beyond that, several power-saving modes can be used to further increase the runtime. The protocol implemented in the firmware is able to address at least 5.5 million balls and can update 60'000 balls within a second. The 3D-printed and ball-shaped housing is watertight and floats on water, while the LEDs always point upwards. Finally, the total material cost (1000 pcs) does not exceed CHF 6.- per ball.
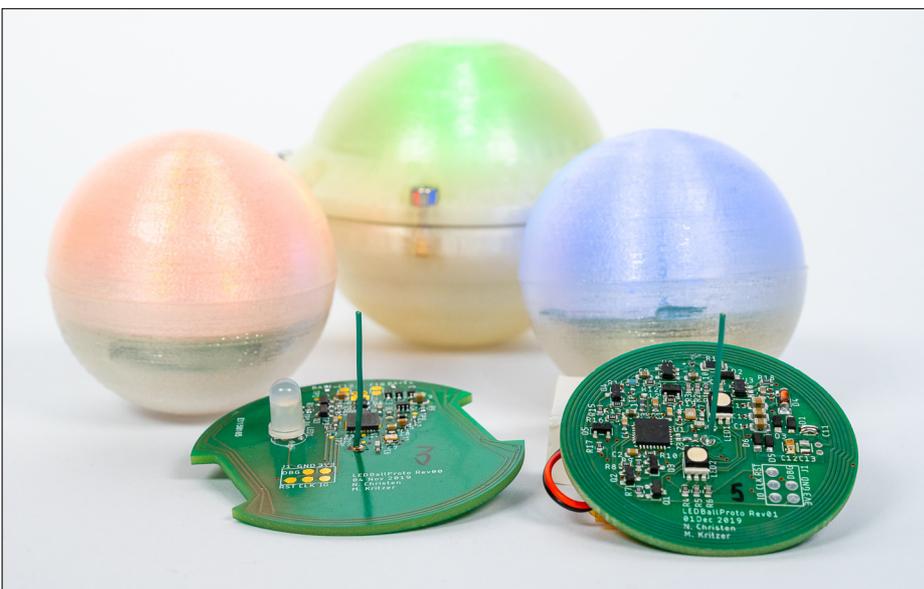
First prototype (Ø 59mm, green ball, left PCB) and second prototype (Ø 48mm, red and blue ball, right PCB).
Own presentment