Emergence in Interactive Embedded Art

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Content

- Emergence
- Human-to-Human interaction (H2H)
- Machine-to-Machine interaction (M2M)
- Machine-to-Human interaction (M2H)
- Human-to-Machine interaction (H2M)
- Hybrid Networks
- Remarks
Emergence is a term used to describe system-level collective behaviors that cannot be reduced to the roles of individual actors. From Aristotle’s “the whole is something besides the parts” to Anderson’s “More is different”, emergence captures the properties of a whole separate from its elements.

Emergence is a broad concept, occurring across physical, technological, biological, neural, and social systems. From physics to philosophy, from engineering to neuroscience, from biology to art, emergent properties are abound, yet there remains little agreement on a formal definition of emergence, ways to analyze it, or ways to achieve it.

We explore an “artistic” design to investigate this phenomenon.
3D projection H2H

Titanic, 2018 (40x40x60, Linux, UC46 mini beamer, 3D light mapping)
LEDs H2H

Rain on the water, 2016 (42x30, acrylic, random blinking RGB LEDs)

Unter Wasser, 2016 (10x10, Acryl, RGB LED, Attiny 85)
LED Stripe H2H

Prospective-Retrospective, 2016
(18x24, diptych, acrylic, ws2812 SMD RGB LED bar, Attiny 85)
Radio M2M

**Good and Evil**, 2017 (16x21, diptych, acrylic, LEDs, 433MHz RF wireless transmitter-receiver, Pro Mini Atmega 168)

**Lotka-Volterra** (1925-26) - predator-prey, Räuber-Beute:

\[
\frac{dB}{dt} = B(a_1 - b_1 R)
\]

\[
\frac{dR}{dt} = -R(a_2 - b_2 B)
\]
Sensor-Actuator M2H

Das Wetter, 2015 (30x20, Acryl, DHT11 Feuchte- und Temperatursensor, LCD 1602-Bildschirm, Pro Mini Atmega 168)

Mumbo Jumbo, 2016 (15x21, acrylic, MQ-2 smoke gases sensor, RGB LEDs, Attiny 85)

Octopus, 2015 (37x27, acrylic, HC-SR501 PIR motion sensor, LEDs, Pro Mini Atmega 168)
City lights, 2017 (18x24, acrylic, ws2812b SMD RGB LED strip, ESP8266 ESP-12)

pUniverse, 2018 (20x30, acrylic, ws2812b SMD RGB LED strip, ESP8266 ESP-12)
Wireless Access Point M2H2M

QR-man, 2017 (18x24, acrylic, RGB LEDs, ESP8266 ESP-01)
Wireless Access Point M2H2M

eGraffiti, 2017 (42x30, acrylic, MAX7219 dot-matrix, ESP8266 ESP-12)
iMondrian, 2017 (40x50, acrylic, MAX7219 dot-matrix, ESP8266 ESP-12)
Two Worlds, 2018 (30x20, acrylic, MAX7219 dot-matrix ESP8266 ESP-12)
Remarks

Interactive artworks explore new forms of engagement, while electronic devices represent an active expressive medium. The author is disappeared, while the audience was born. Interactive computer art enables unexpected side effects:

- 3D light projection and LED lights mounted on the front surface or under the canvas evoke positive emotions in audience members. Artwork is catalyst when participants communicate with each other;

- Lotka-Volterra model determines a “competitive” interaction between two microcontrollers with RF wireless connection;

- Temperature, gas and motion sensors with actuators as LCD screen and LEDs embedded in artworks provide funny machine-to-human communication;

- Most curious artworks play as a soft AP that establishes the wireless network allowing Wi-Fi connection from smartphones or tablets.

Emergence is often a product of particular pattern of interaction: microcontroller ⇔ physical world ⇔ human.