LICHTTECHNISCHE GESELLSCHAFT ÖSTERREICHS

JOANNEUM RESEARCH MATERIALS

Die Zukunft des Lichts: Mehr als nur Beleuchtung

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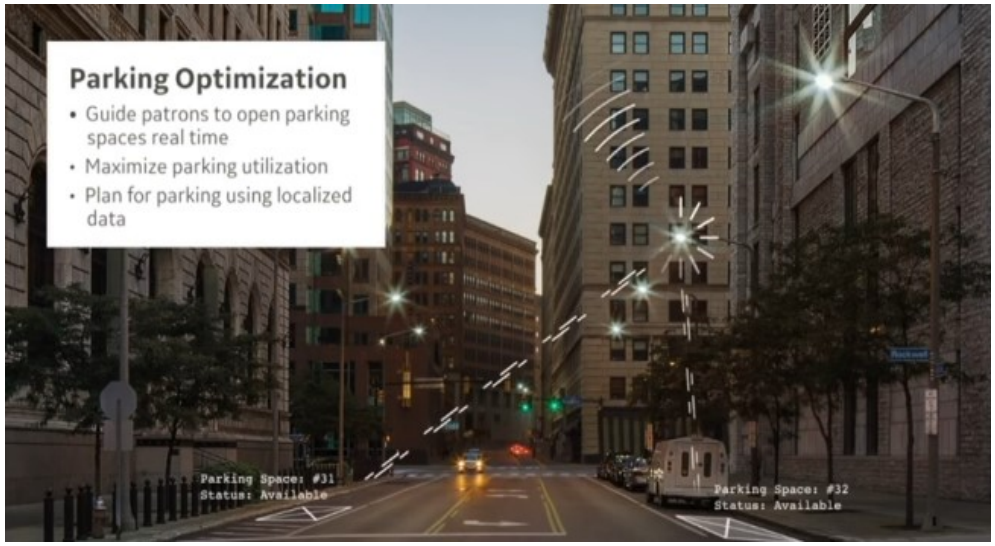
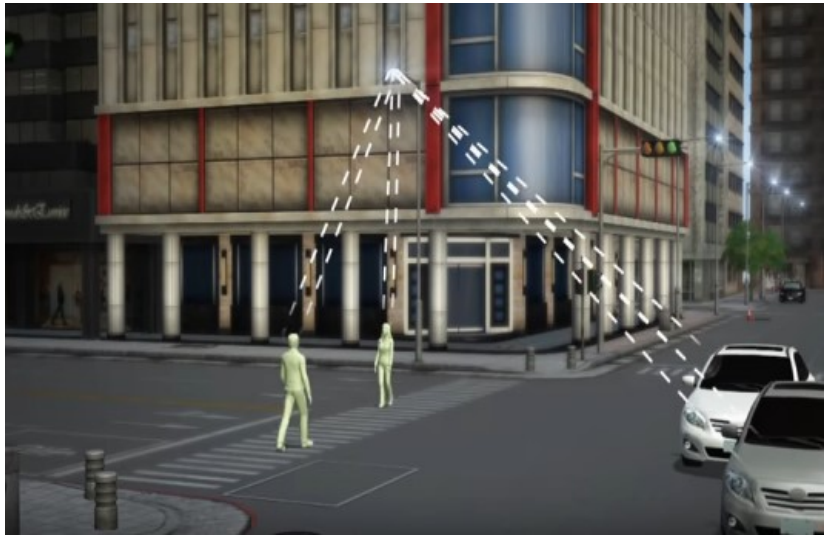
A-7423 Pinkafeld (AUSTRIA)

JOANNEUM RESEARCH MATERIALS

- **Smart Electronic based Systems**
- **Systems of Systems: Communication and Connectivity**
- **Integrative Lighting**

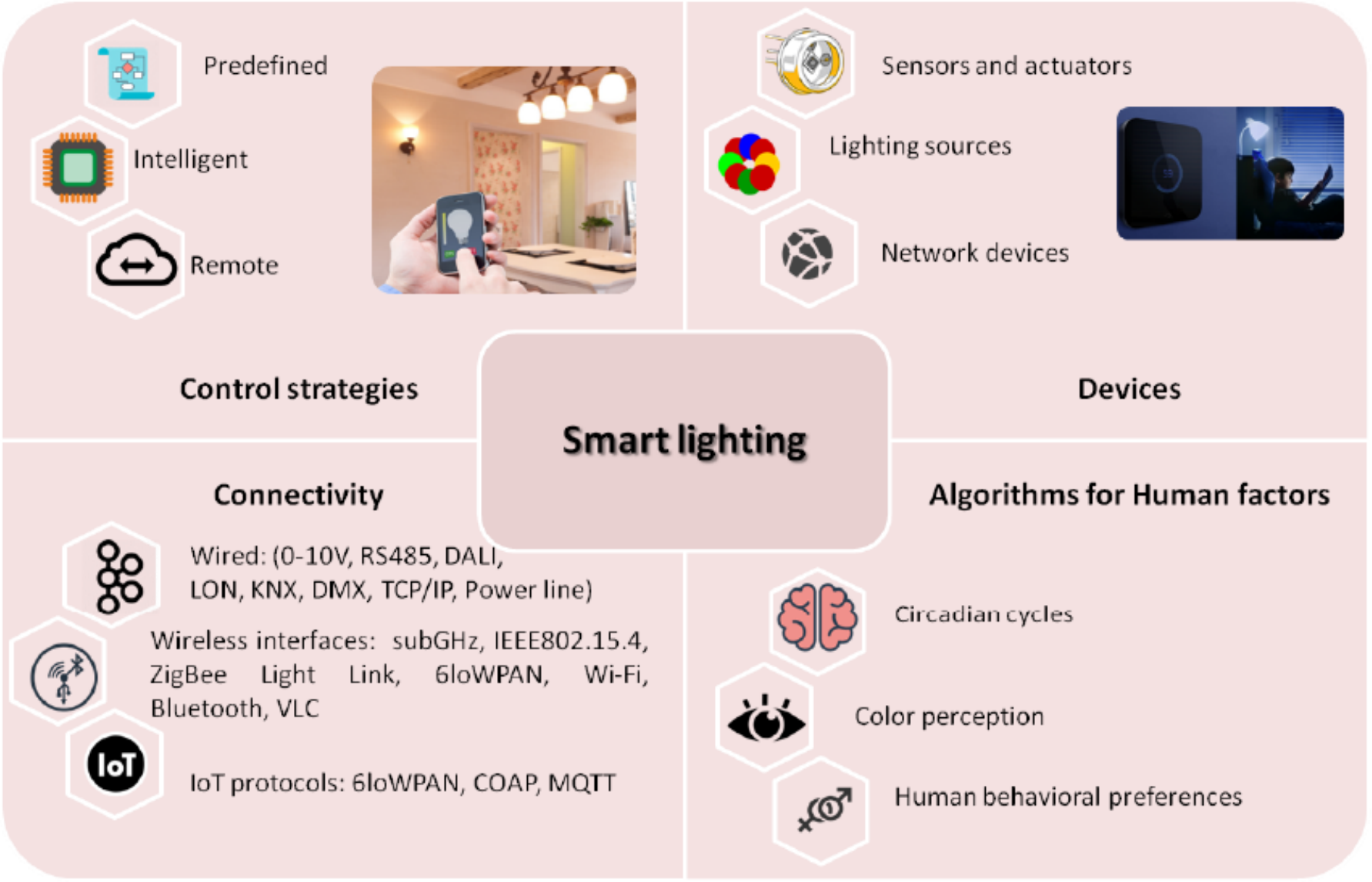
https://www.zumtobel.com/nl-nl/active-light.html





San Diego: Smart Streetlights to Provide World's Largest "Internet of Things" Platform

https://www.sandiego.gov/sustainability/energy-and-water-efficiency/programs-projects/smart-city

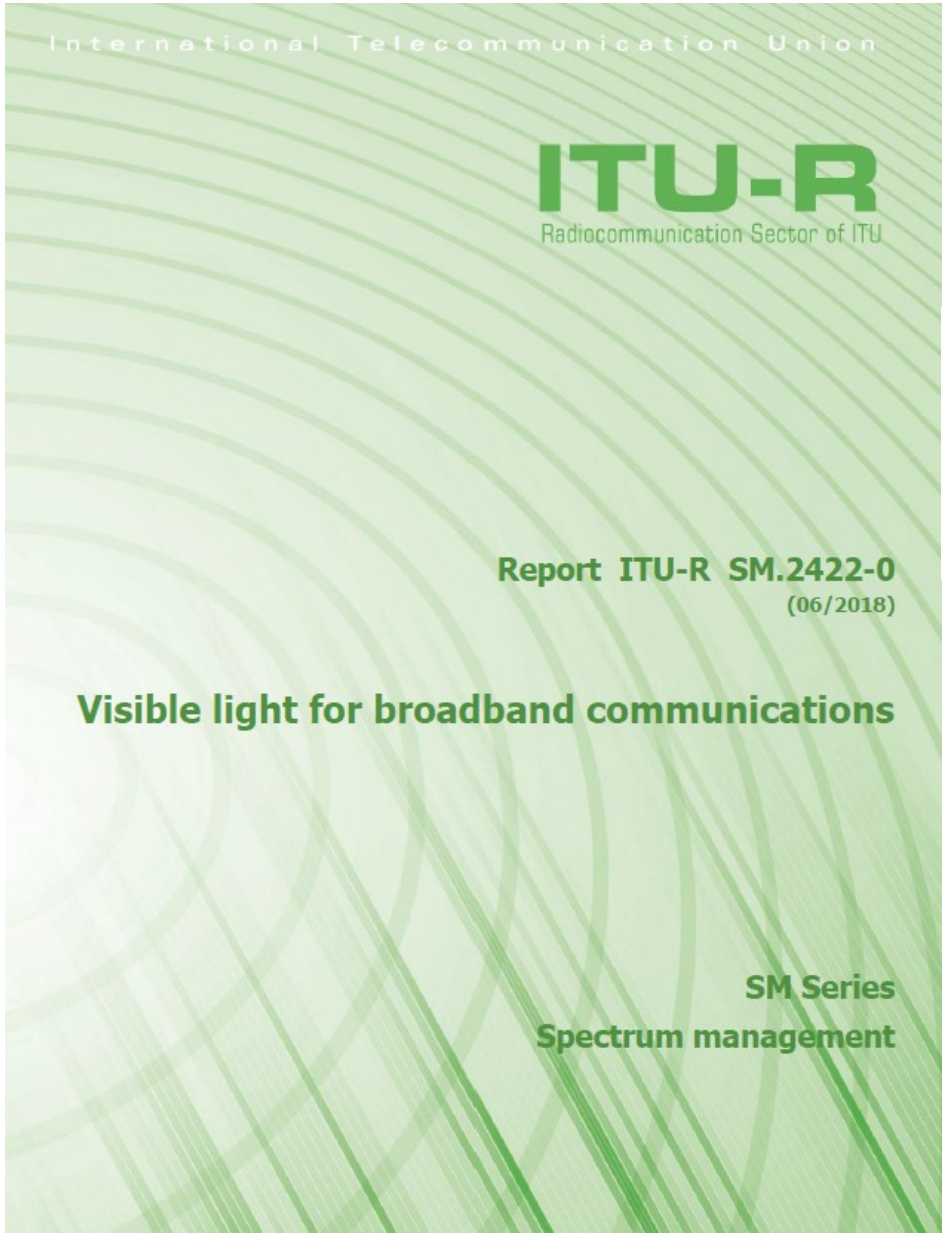


J. Higuera et al., Trends in smart lighting for the Internet of Things, arXiv:1809.00986

Welche andere Funktionalitäten könnte das Licht übernehmen?

Wir brauchen künstliches Licht für die Beleuchtung.
Warum sollten wir es nicht auch für Kommunikation verwenden.

www.TED.com



7 Conclusions

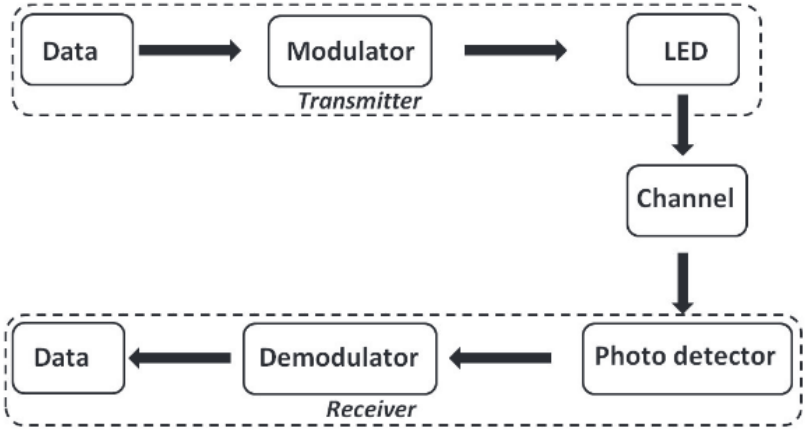
Recent developments in OWC, standardization activities and existing lighting products show that VLC is a mature technology with many benefits for offloading the radio spectrum.

It may be concluded that the management of VLC devices and the VLC spectrum is not a regulatory task but something that should be organized in technical standards. A close cooperation of the

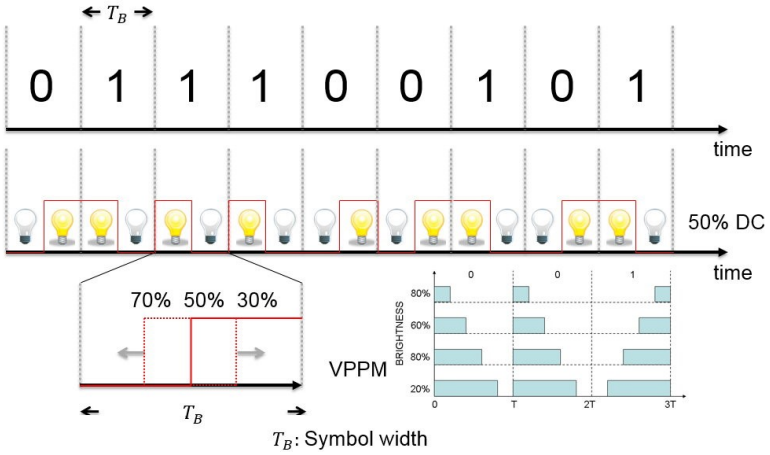
standardization bodies involved in VLC and those in the traditional radio applications could be beneficiary.

https://www.itu.int/pub/R-REP-SM.2422-2018

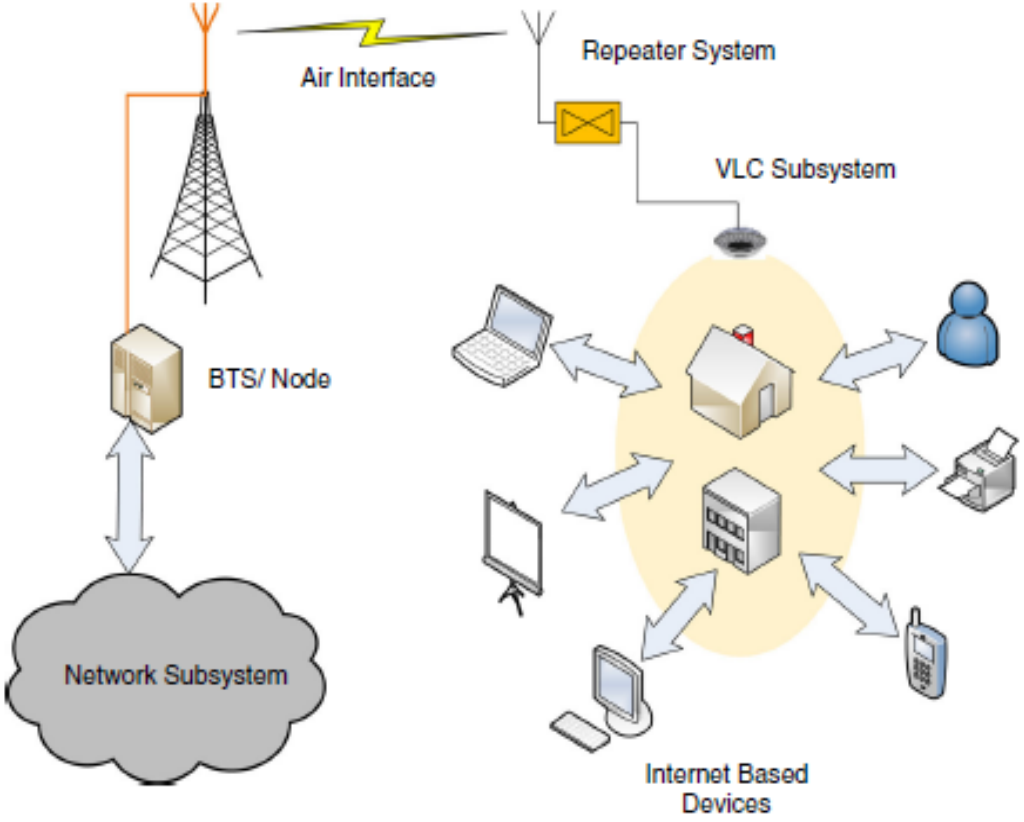
Visible Light Communication



A. R. Ndjiongue, H. C. Ferreira, T. Ngatched, Wiley Encyclopedia of Electrical and Electronics Engineering. Visible Light Communications (VLC) Technology, pp.1-15, (2015)

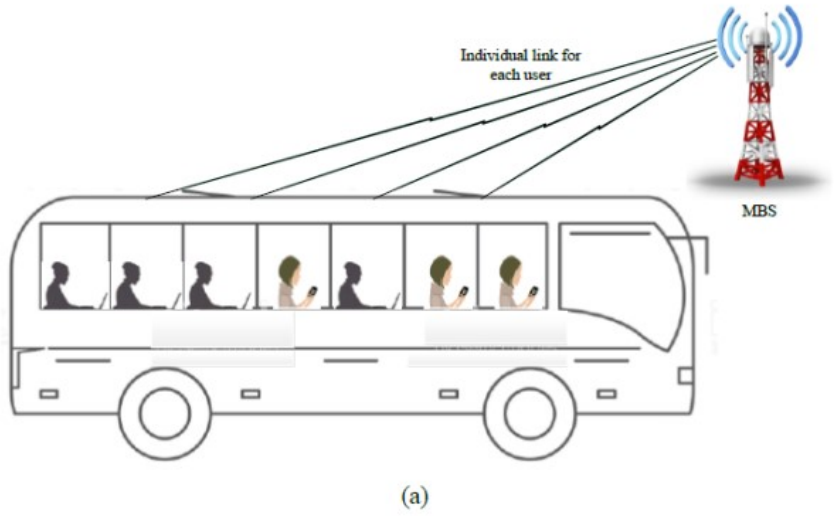


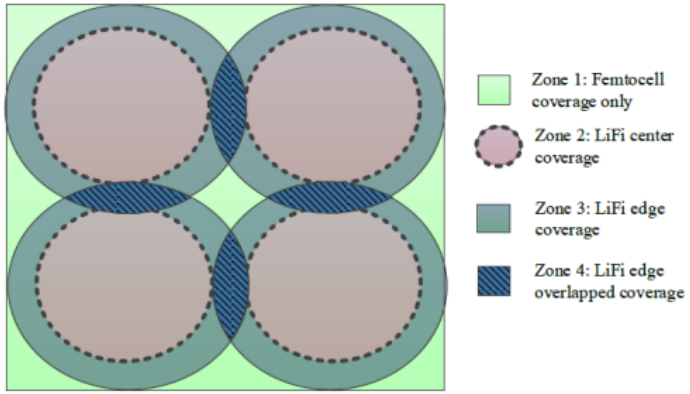
https://e2e.ti.com/support/archive/launchyourdesign/m/msp430microcontrollerprojects/665142

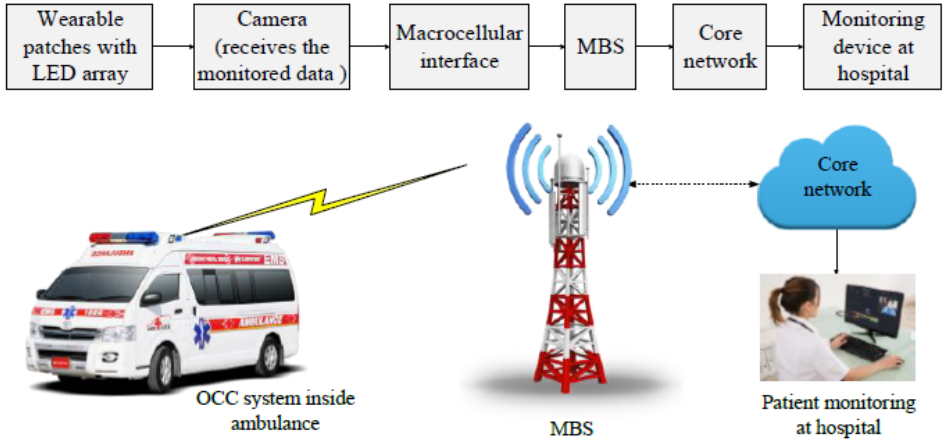


A. Kumar, A. Mihovska, S. Kyriazakos, R. Prasad, Visible light communication (VLC) for ambient assisted living, Wireless Pers. Commun. 78, pp. 1699-1717, (2014)

Visible Light Communication







M. Z.n. Chowdhury, M. T. Hossan, M. K. Hasan, Y. M. Jang, Integrated RF/Optical Wireless Networks for Improving QoS in Indoor and Transportation Applications, Wireless Personal Communications, in print

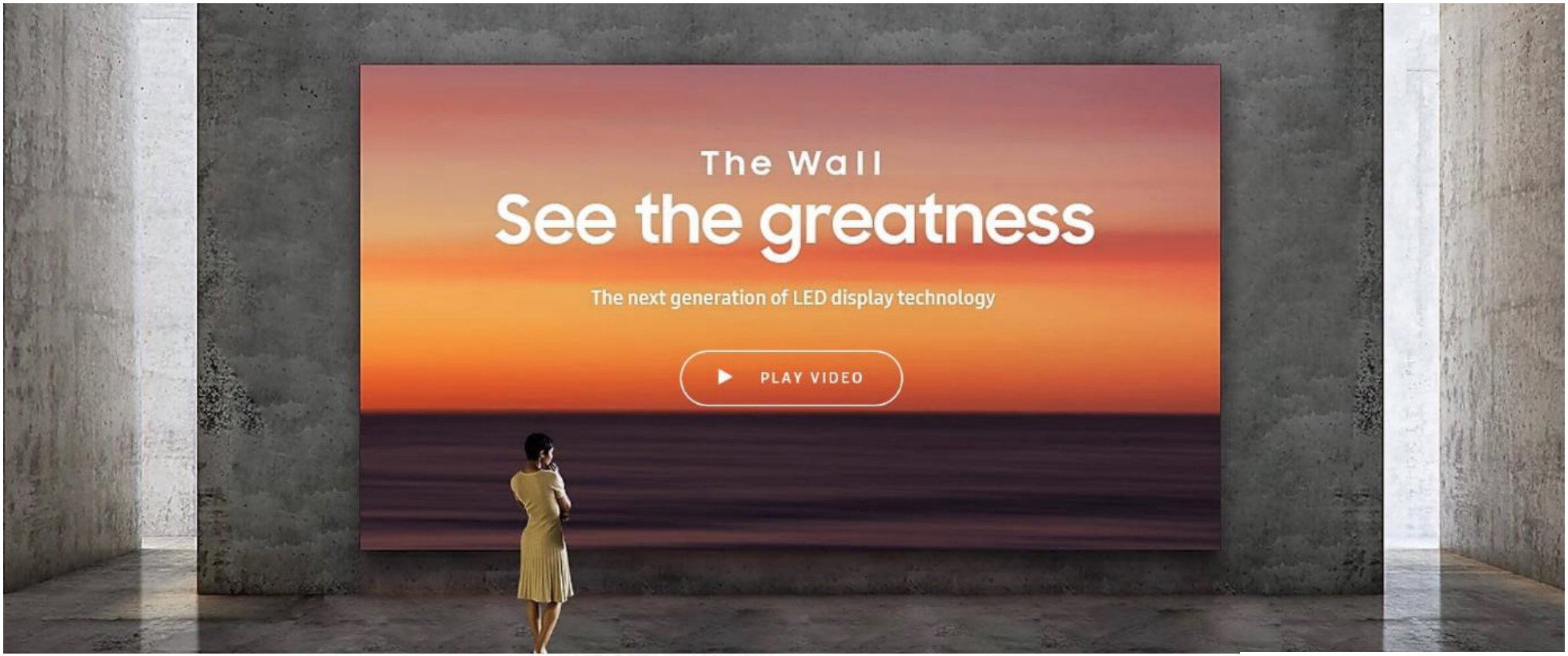
Download vom Internet…

…wird das immer so bleiben?

https://blog.beaconstac.com/2016/05/li-fi-vs-wi-fi-vs-ibeacon-ble-technology/

Lichttechnischer Kongress 2019

LICHTTECHNISCHE GESELLSCHAFT ÖSTERREICHS



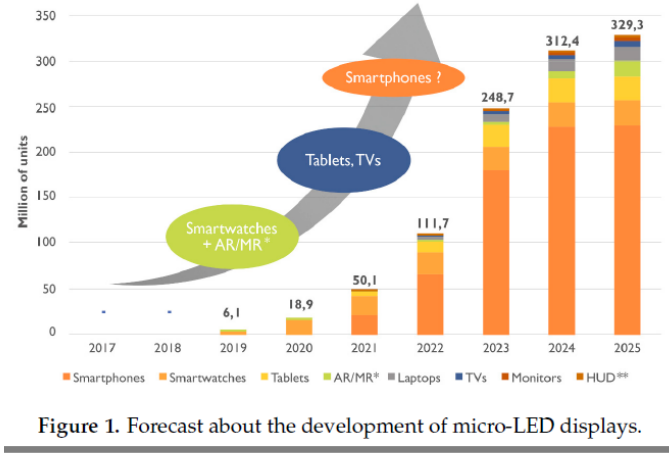
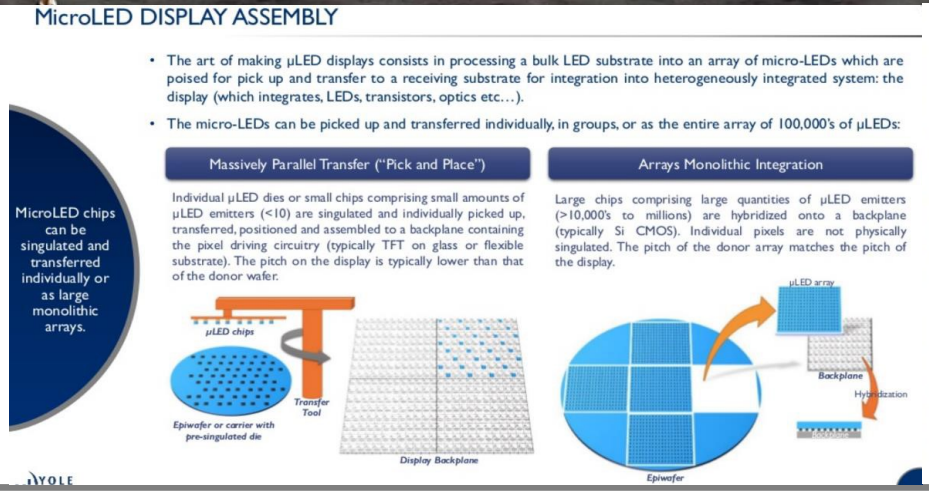
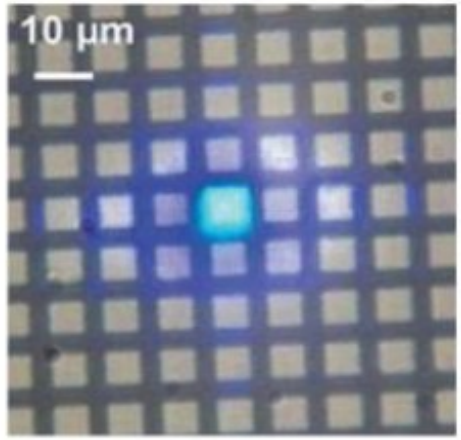


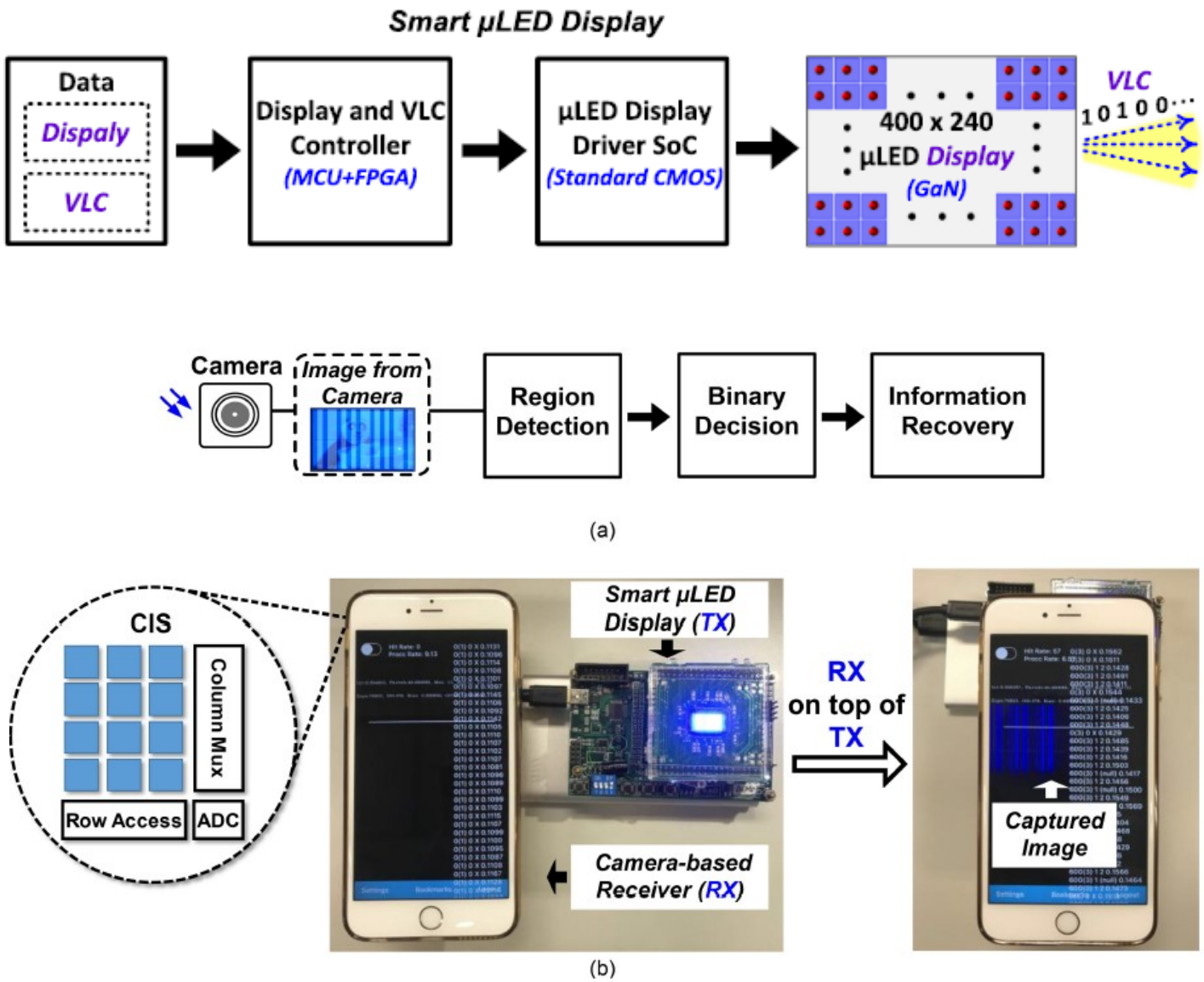
Figure 1. Forecast about the development of micro-LED displays.





Franz-Peter Wenzl

https://www.samsung.com/us/business/products/displays/direct-view-led/the-wall/
http://www.leti-cea.fr/cea-tech/leti/Pages/Accueil.aspx, https://www.mdpi.com/2076-3417/8/9/1557/pdf



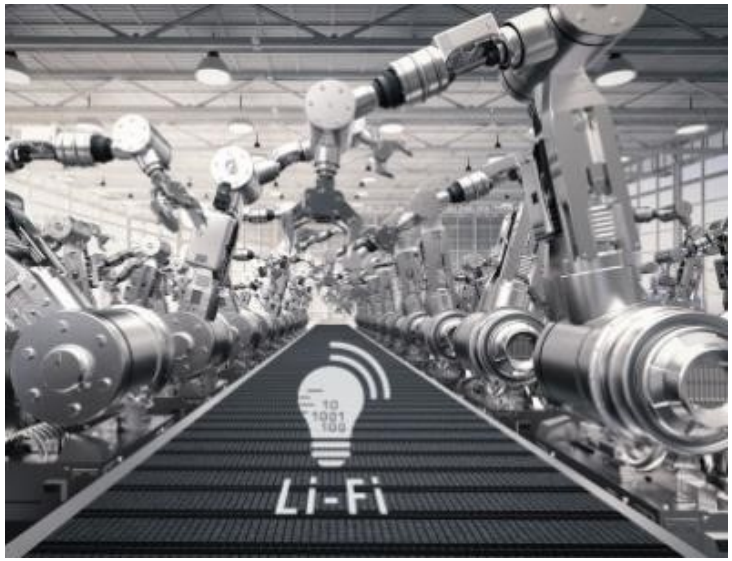
https://ieeexplore.ieee.org/document/8613010

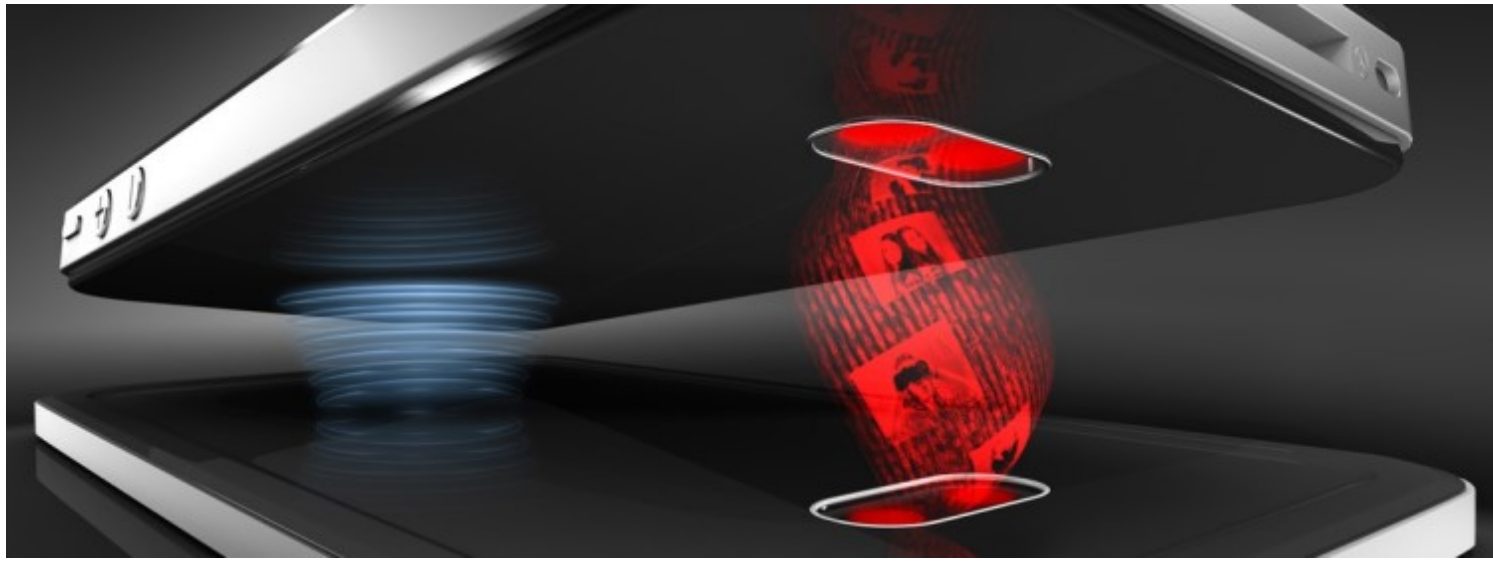
Displays, Beleuchtung und Kommunikation werden zusammenwachsen

Apple stellt seine Displays nicht selbst her, sondern lässt sie von verschiedenen koreanischen und japanischen Zulieferern produzieren, u. a. von LG Display, Samsung und Japan Display.

Apple currently uses OLED displays for the high-end iPhones and the Apple Watch, but it's reportedly developing its own in-house MicroLED displays for use in mobile devices, starting with the watch.

https://www.cnet.com/news/microled-oled-screen-technology-samsung-the-wall/



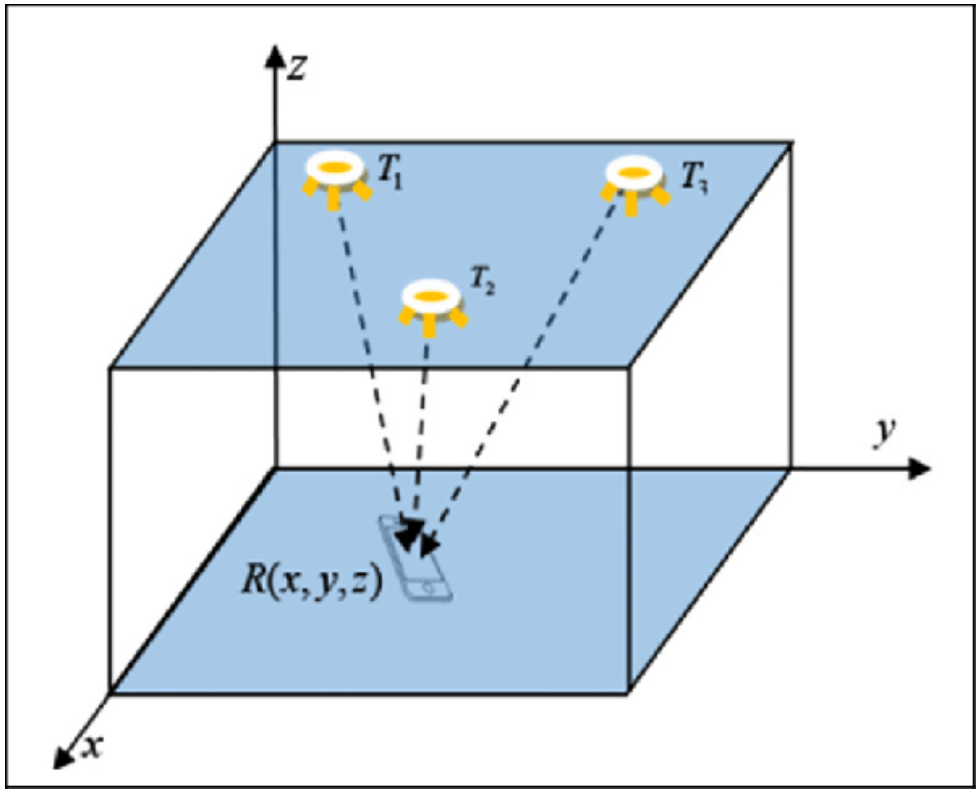


Industrie 4.0: Maschinen in Lichtgeschwindigkeit orchestrieren

Eine Branche, für die Li-Fi besonders interessant werden könnte, ist die Produktions- und Fertigungsindustrie. Denn: Sollen kritische Infrastrukturen vernetzt werden, ist Sicherheit das A und O. Noack erläutert: „Der begrenzte Aktionsradius von Li-Fi ist hier ein Vorteil, da er stets an der Wand einer Fabrikhalle endet. Darüber hinaus haben Produktionsroboter, Fertigungsbänder und -maschinen einen zumeist festen Platz in der Produktionslandschaft und bewegen sich nur in kontrollierten Radien und Arealen." So lässt sich leicht gewährleisten, dass die benötigte Sichtverbindung zwischen Leucht- und Photodiode unterbrechungsfrei bestehen bleibt. Und: Datenverbindungen über Lichtwellen müssen auch nur solange bestehen bleiben, wie sie ad hoc benötigt werden. Sind die Informationen übertragen, erlischt das Signal sofort. Die enorme Geschwindigkeit der Datenübertragung bietet der Industrie außerdem minimale Latenzzeiten: Maschinen lassen sich sinnbildlich in Lichtgeschwindigkeit über Befehle orchestrieren – dank Li-Fi.

https://www.t-systems.com/at/de/newsroom/blickwinkel/netze/leistung/li-fi-664680
https://www.ipms.fraunhofer.de/de/research-development/wireless-microsystems/LiFi/lifi-gigadock.html

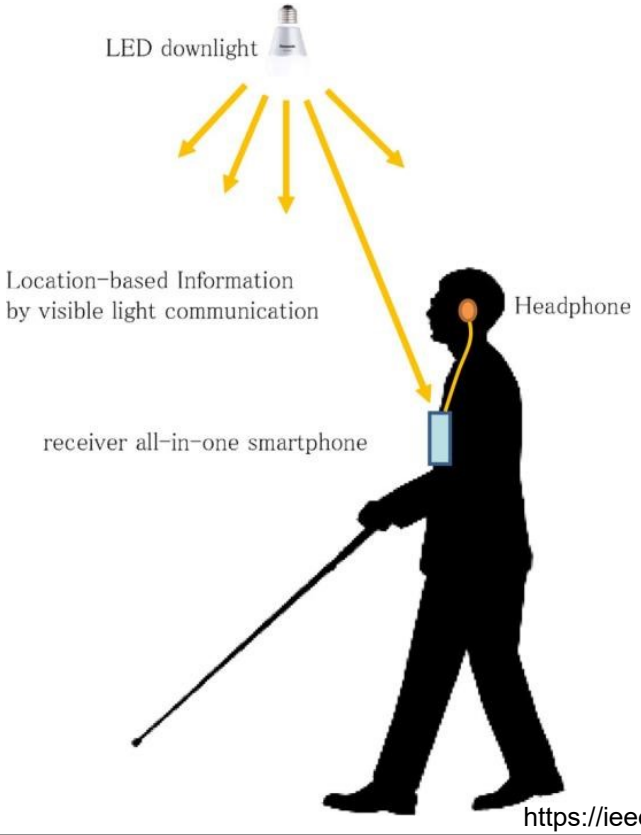
Indoor Lokalisierung



Mehrere Technologien stehen zur Auswahl

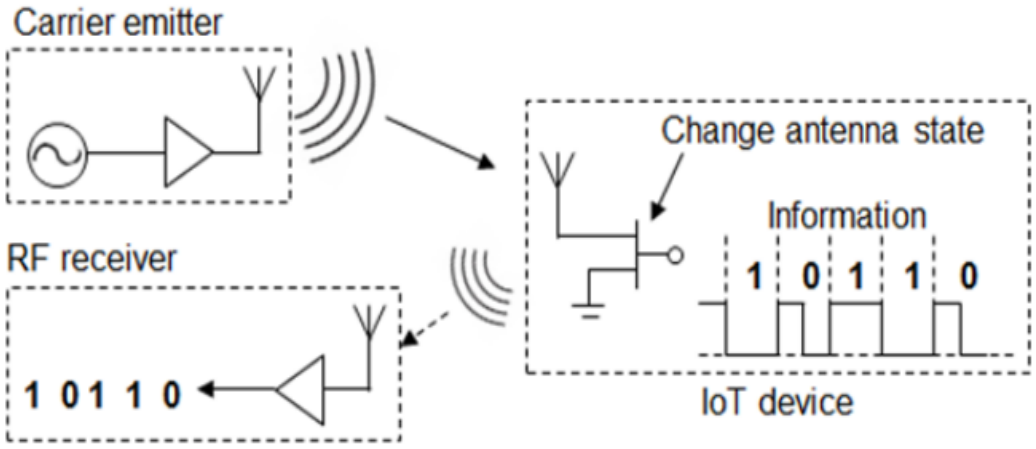
- WiFi, RFID, IR, Zigbee …..
- Positioniergenauigkeit ~ 1 meter

Indoor Lokalisierung mit Licht erlaubt Genauigkeiten im cm-Bereich

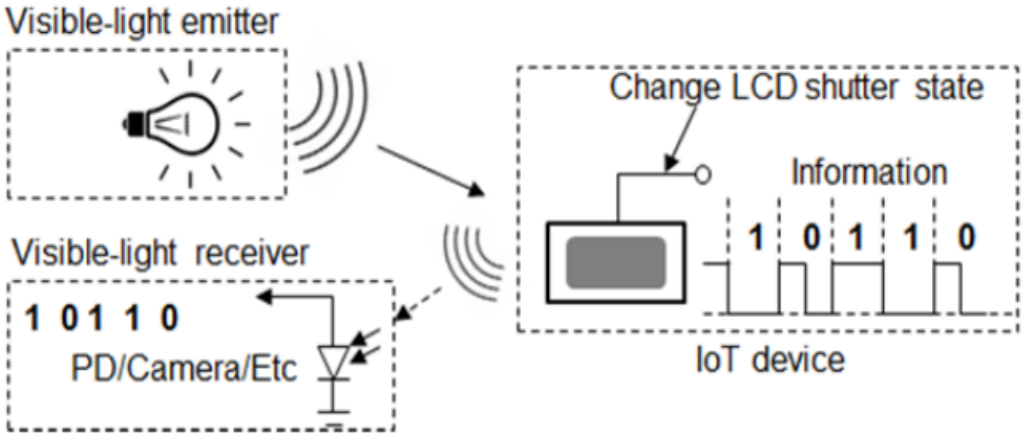


https://ieeexplore.ieee.org/document/6356940

Visible Light Sensing/Backscattered VLC

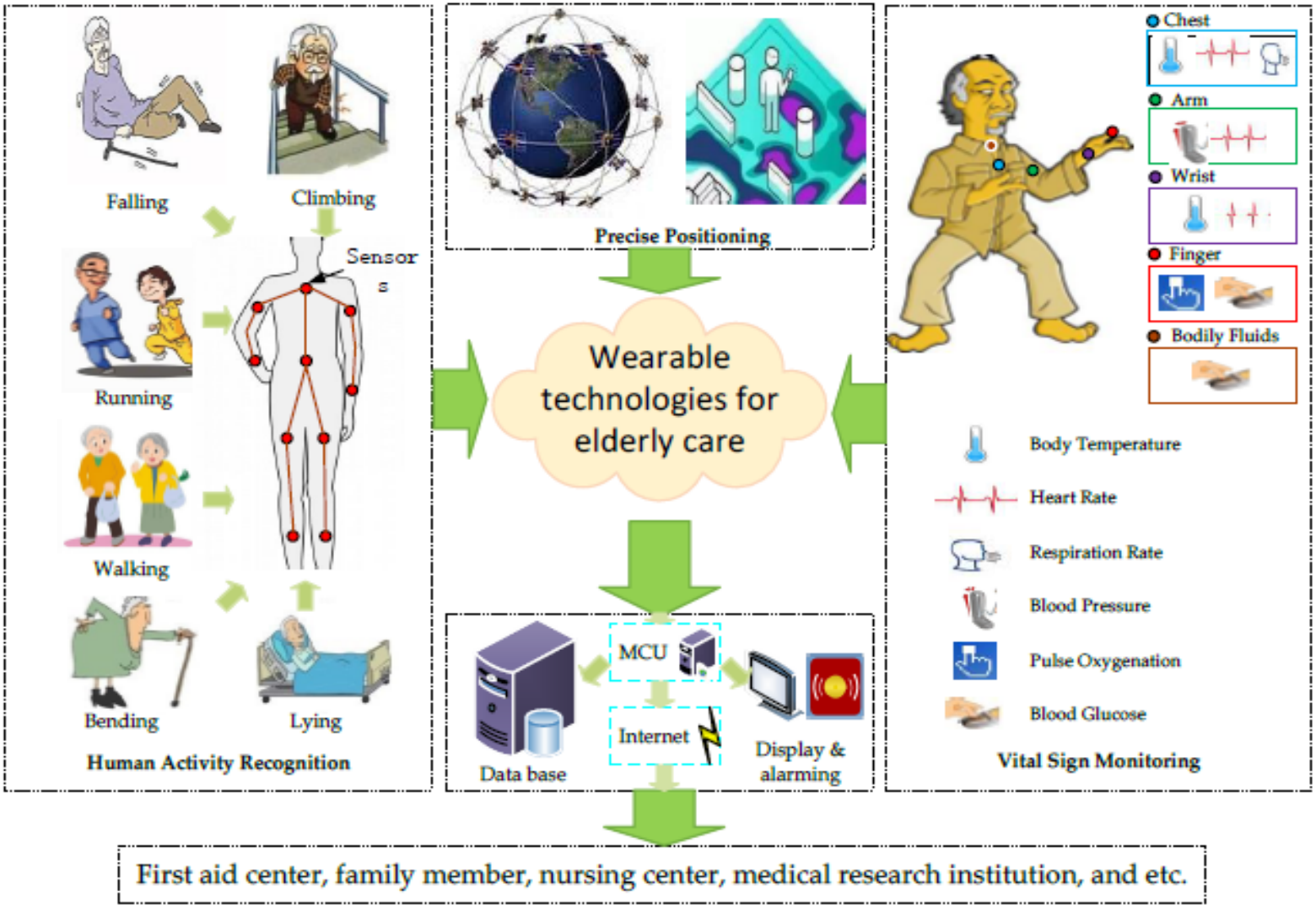


Ambient RF backscatter

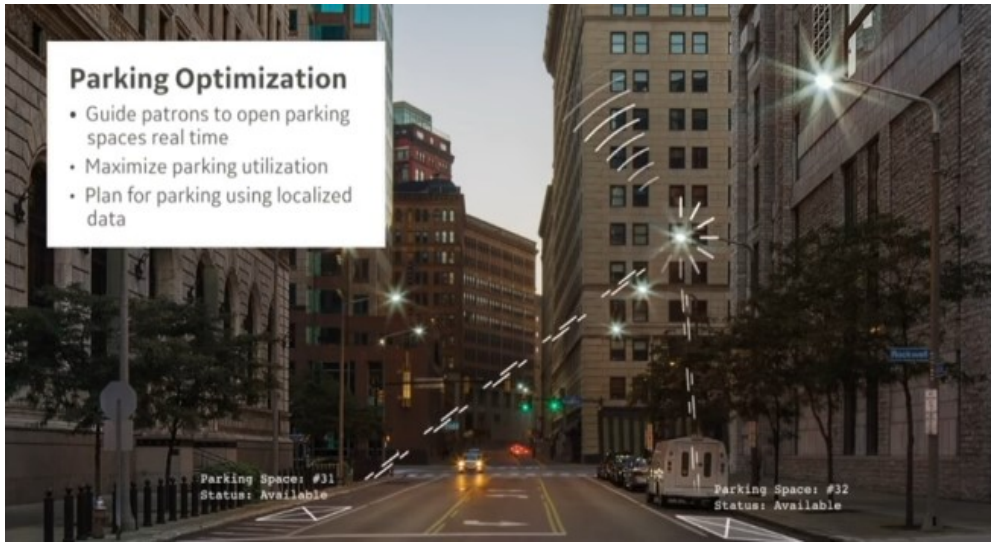


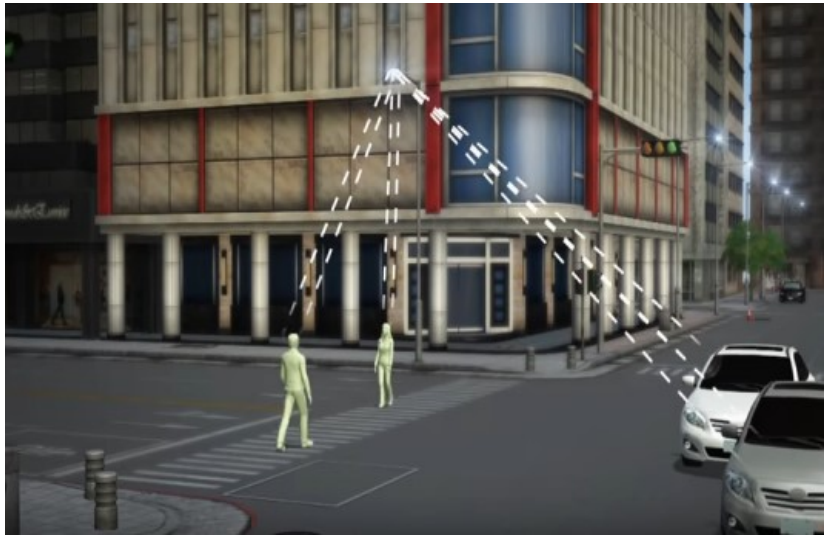
Ambient light backscatter

J. Yun, B. J. Jang, Ambient light backscatter communication for IoT applications. Journal of Electromagnetic Engineering and Science, 16, pp.214-218, (2016)



Z. Wang, Z. Yang, T. Dong, A Review of Wearable Technologies for Elderly Care that Can Accurately Track Indoor Position, Recognize Physical Activities and Monitor Vital Signs in Real Time, Sensors 10, E341, (2017)





San Diego: Smart Streetlights to Provide World's Largest "Internet of Things" Platform

Smart lighting

Control strategies

- Predefined
- Intelligent
- Remote

Devices

- Sensors and actuators
- Lighting sources
- Network devices

Connectivity

- Wired: (0-10V, RS485, DALI, LON, KNX, DMX, TCP/IP, Power line)
- Wireless interfaces: subGHz, IEEE802.15.4, ZigBee Light Link, 6loWPAN, Wi-Fi, Bluetooth, VLC
- IoT protocols: 6loWPAN, COAP, MQTT

Algorithms for Human factors

- Circadian cycles
- Color perception
- Human behavioral preferences

Connected Lighting

Connected BY Lighting

Danke für Ihre Aufmerksamkeit

https://slideplayer.com/slide/10504846/

Dieses Projekt wird von Bund und Land Burgenland sowie dem Europäischen Fonds für Regionale Entwicklung im Rahmen des Programms Investitionen in Wachstum und Beschäftigung kofinanziert.

EUROPÄISCHE UNION
Europäische Struktur- und Investitionsfonds

BURGENLAND
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