Environmental monitoring in built environment through wearable devices: a bibliometric review

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Francesco Salamone: short resume of presenter

PhD candidate - University of Campania "Luigi Vanvitelli"
Researcher - Construction Technologies Institute of the National Research Council of Italy
Environmental Engineer - University of Pavia

Interest areas:
Indoor Environmental Quality,
Indoor Air Quality,
Thermal Comfort,
IoT,
Machine Learning techniques for data analysis,
Monitoring system,
Energy Efficiency,
Parametric simulation,
3D printing,
Virtual Reality research applications

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https://www.cnr.it/en/people/francesco.salamone

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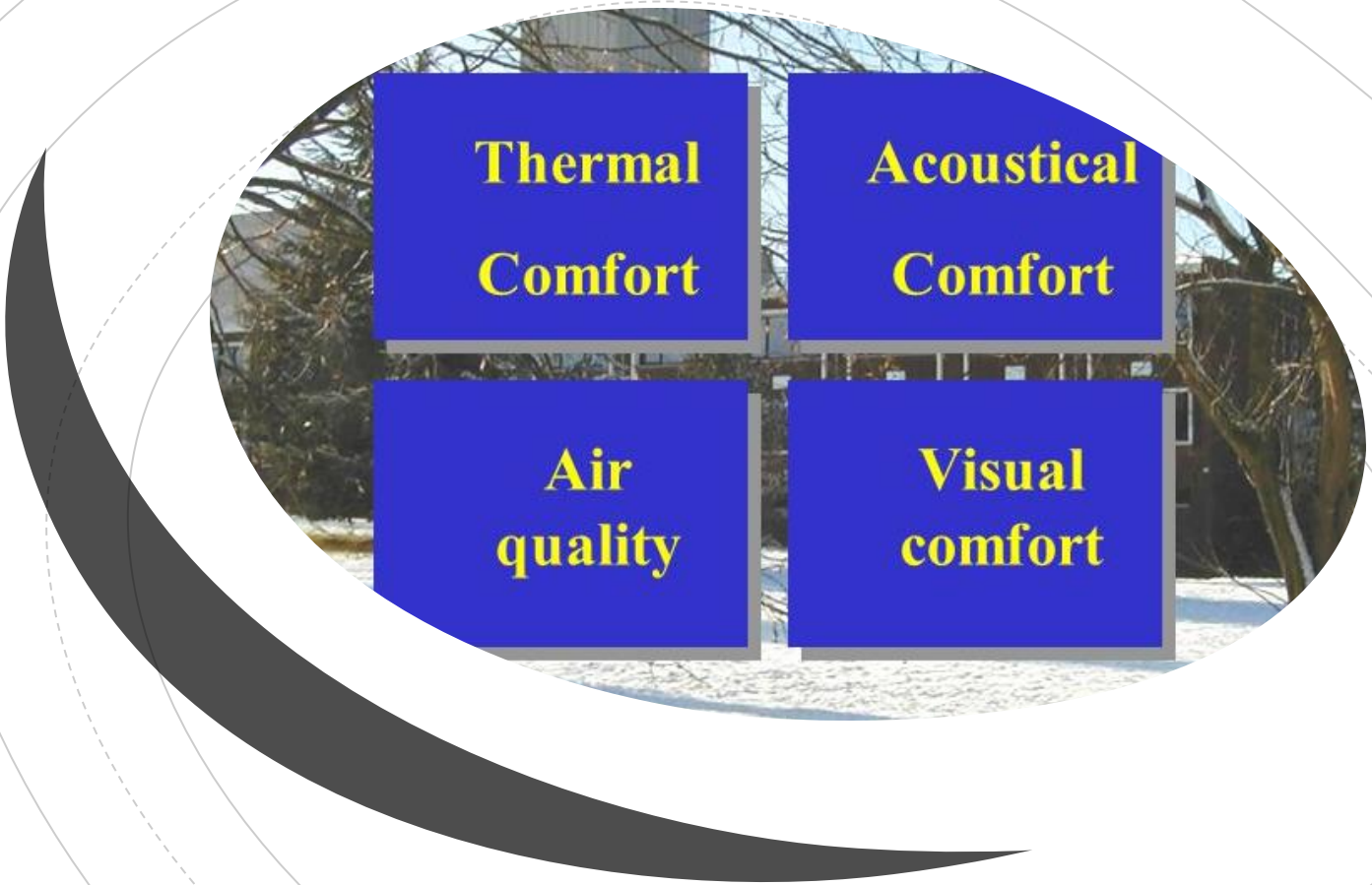
Environmental Factors to be considered in the Built Environment



Environmental Quality (EQ) can be subdivided by analyzing it in terms of Indoor EQ (IEQ) or Outdoor EQ (OEQ). Both IEQ and OEQ are important to ensure the health and well-being of people.

Both IEQ and OEQ refer to a holistic concept that includes various environmental factors: visual, acoustic, thermal and air quality.

Wearables

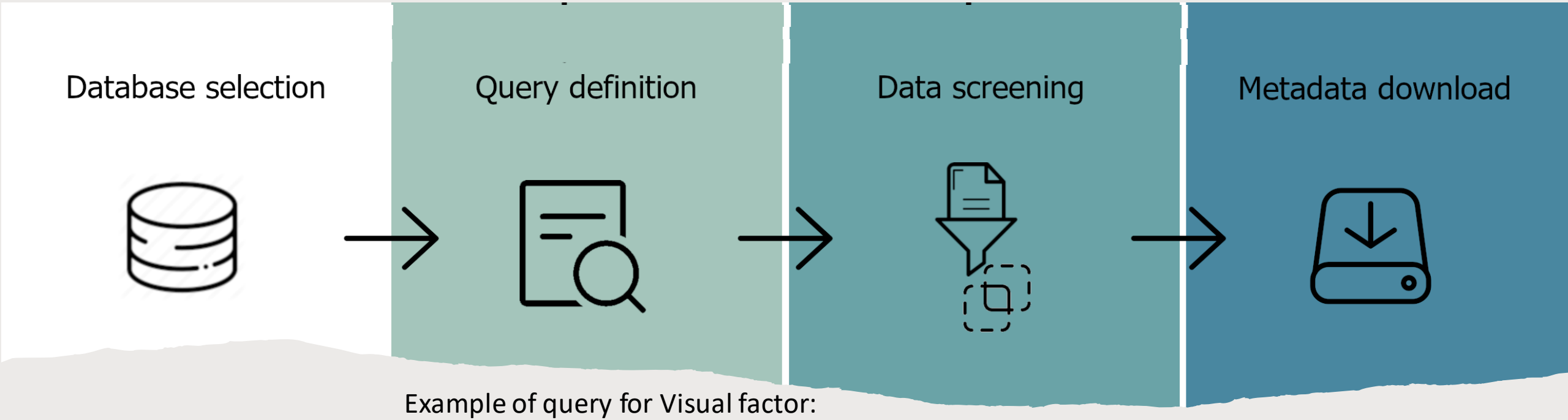
R.W. Picard, J. Healey, Affective wearables, Int. Symp. Wearable Comput. Dig. Pap. (1997) 90–97.

"a system equipped with sensors that allowed the detection of affective patterns, such as heart rate variability, electrodermal activity, etc."

W. Gao, S. Emaminejad, H.Y.Y. Nyein, S. Challa, K. Chen, A. Peck, H.M. Fahad, H. Ota, H. Shiraki, D. Kiriya, D.H. Lien, G.A. Brooks, R.W. Davis, A. Javey, Fully integrated wearable sensor arrays for multiplexed in situ perspiration analysis, Nature. (2016) 509–514.

"category of devices that can be worn or tattooed on the human skin or even implanted in the human body to continuously and accurately monitor some variables (biometric in most of cases, but also environmental in some other cases) without interrupting or restricting the user's movements"

Bibliometric review: Methodology



Example of query for Visual factor:

TITLE-ABS-KEY ((wearable OR pems OR wems) AND (daylight OR "color temperature" OR lighting OR luminance OR glare OR "dosimeter" OR "lux meter" OR "light meter" OR "color meter" OR colorimeter OR "luminance meter" OR photometry OR visual) AND (environmental W/3 monitoring) AND NOT ("proton exchange membrane" OR "fuel cell")) OR EID (2-s2.0-27344452309 OR 2-s2.0-77956754851 OR 2-s2.0-85042561689 OR 2-s2.0-79957588325 OR 2-s2.0-84879967631 OR 2-s2.0-77953632392 OR 2-s2.0-81255124342 OR 2-s2.0-79952959932 OR 2-s2.0-84928173018 OR 2-s2.0-84960113897 OR 2-s2.0-84918811426 OR 2-s2.0-84907667703 OR 2-s2.0-85096669247) AND NOT EID (2-s2.0-41849089305 OR 2-s2.0-85047120790 OR 2-s2.0-85052730774 OR 2-s2.0-84933505542 OR 2-s2.0-85044290759 OR 2-s2.0-84885042666 OR 2-s2.0-84952011313 OR 2-s2.0-85066239722 OR 2-s2.0-85087571429 OR 2-s2.0-85067399950 OR 2-s2.0-84855470006 OR 2-s2.0-85030837996 OR 2-s2.0-85086035889) AND (EXCLUDE (DOCTYPE , "cr"))

10.3390/s21144727

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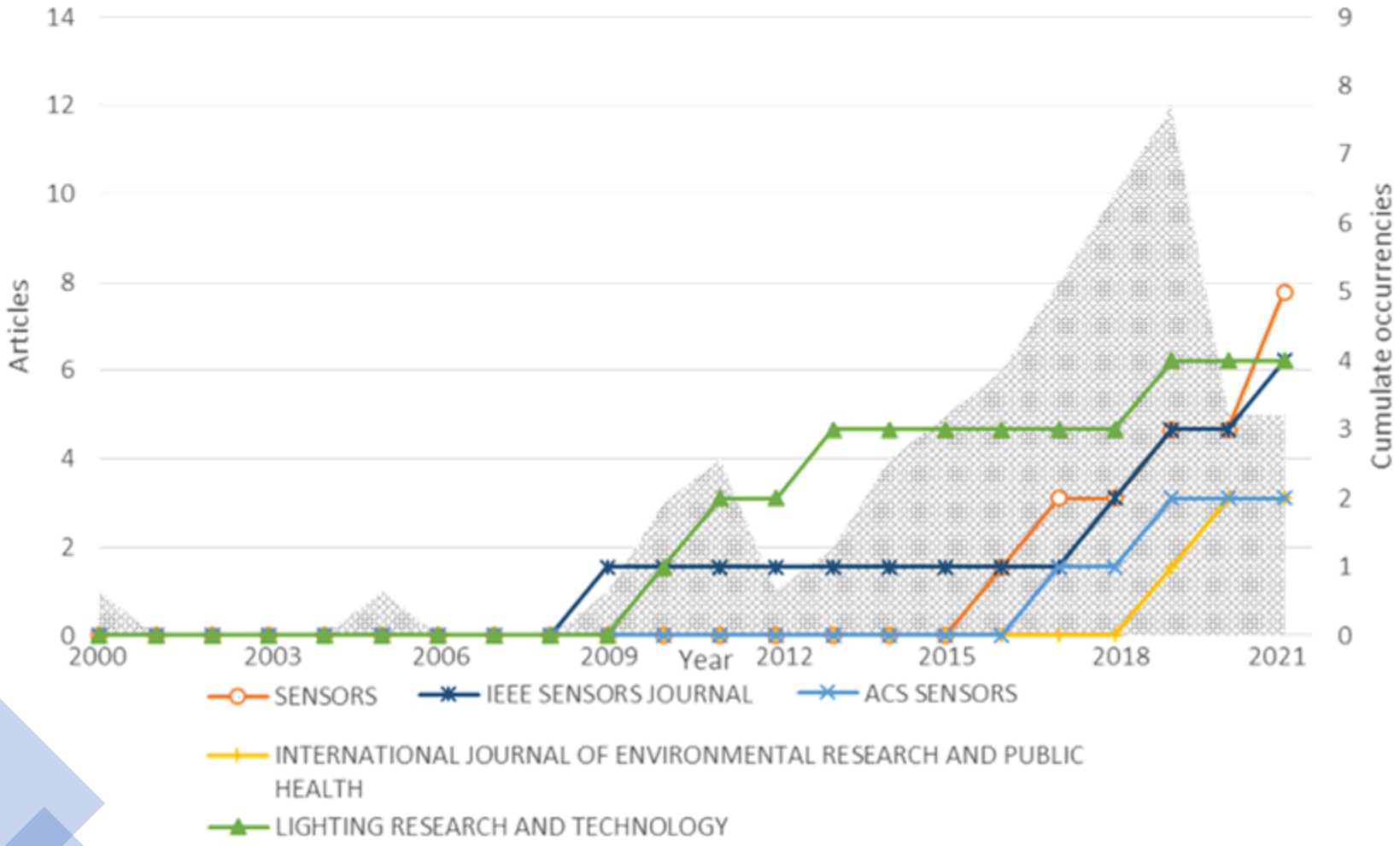
Acquired data

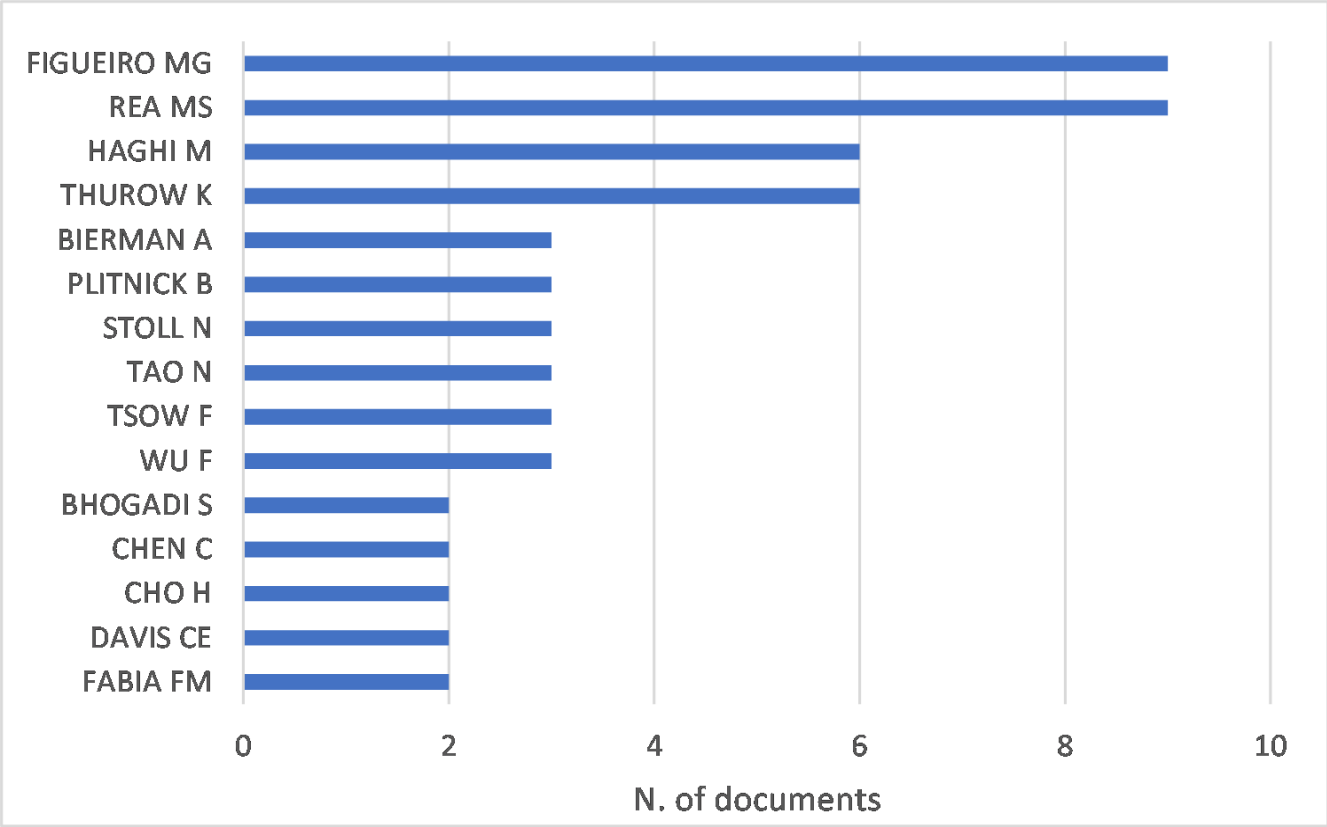
- Visual (16 resulting papers from 2005 to 2021);
- Acoustic (11 resulting papers from 2013 to 2021);
- Thermal (19 resulting papers from 2011 to 2021);
- Air Quality (39 resulting papers from 2000 to 2021)

Descriptive analysis



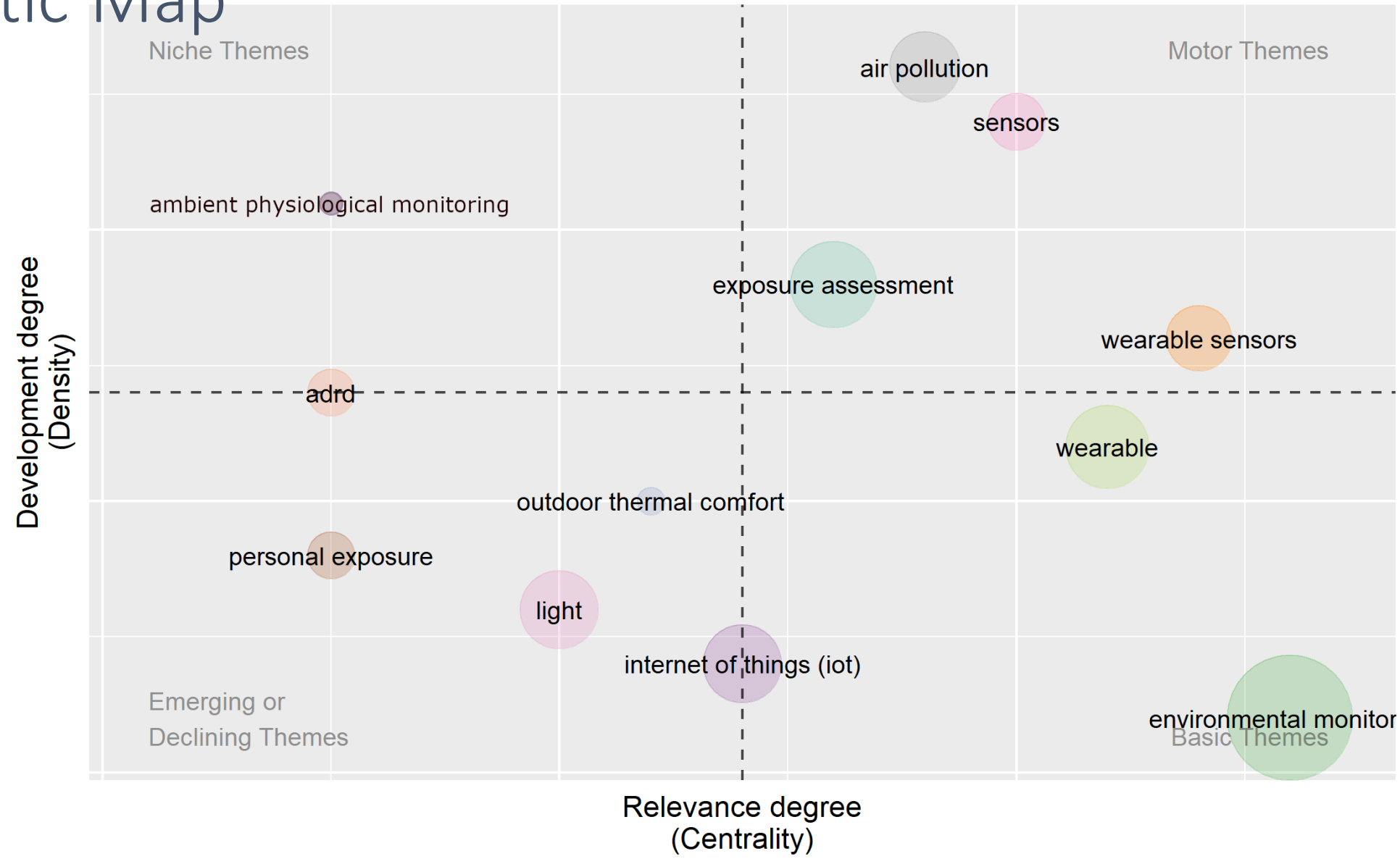
- Documents: 68 different papers
- Period: 2000:2021
- Sources: 55
- Average citations per Article: 18.78

Top 15 authors



- Authors of single-authored documents: 3
- Authors of multi-authored documents: 314
- Author per article index: 4.66
- Collaboration index: 4.91

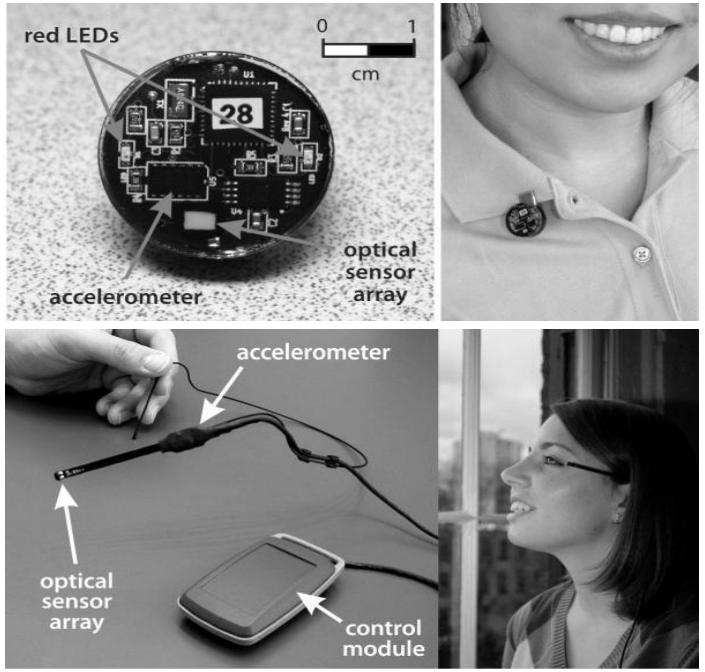
Thematic Map



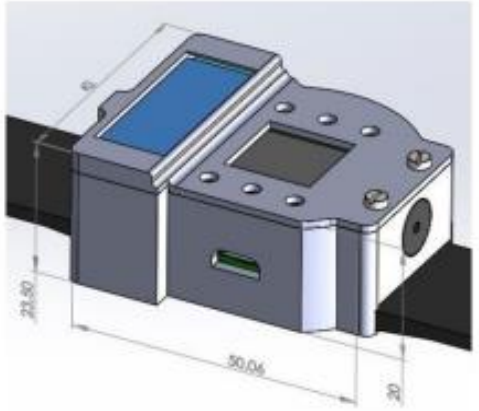
Some relevant studies

Wearable for PM2.5 detections

Daysimeter



Multi-tasking watch for environmental monitoring



Most important findings and limitations

Findings

- visual aspects focused mainly on indoor environments.
- acoustic EF studies have mainly focused on investigating the health effects of combined acoustic and air environmental exposures.
- thermal EF is usually used in combination with some others to determine the overall environmental conditions while conducting the test
- air quality is the most considered in the use of wearables, and the case studies span multiple domains.

Limitations

- No real integration of wearables in clothing
- No real diffusion of open-source project
- No all-inclusive approach to consider all 4 environmental factors from a human-centric perspective

Please, also refer to the following complementary paper for the systematic review:

Salamone, F.; Masullo, M.; Sibilio, S. Wearable Devices for Environmental Monitoring in the Built Environment: A Systematic Review. Sensors 2021, 21, 4727. https://doi.org/10.3390/s21144727

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