

Table S1: Additional characteristics of the included interventions.

	Digital architecture	Type of data	Interaction with real world	Case study
Candelieri A, 2013 [31]	Technologies comprehend sensors data integrators, geographical information systems (GIS), predictive and simulation models, data analytics tools, popular social networking platforms. LENVIS is a collection of several web services, with data acquired through sensors and generated by users. A specific Health service analyzes relations between pollutant concentrations and health impact and providing health indicators. GIS geo-refers data and information; Business Analytics Tools, Data-driven and Model-driven Predictions and Decision Support to personalize informations according to the user. The Web Portal, the Mobile Applications and the Social Networks are responsible for the interaction mechanism between the users and the system.	Environmental data, healthcare data	Show the users an up-to-date status of the presence of pollutants in the air or water to direct them toward informed choices.	The system has been tested in Milan and in Portugal. In Milan, it is able to support: local authorities in monitoring pollution level and evaluating the effectiveness of environmental policies; healthcare providers in planning effective resource allocation and improving the diagnosis of pollution-related conditions; citizens in planning outdoor activities or in receiving personalized alerts toward groups at risk in the population. In Portugal, in three cities (Carcavelos, Torre, and Santo Amaro de Oeiras) the system provides information about water quality to surfing groups who use social networks to meet online.
Bravo Y, 2016 [26]	Use of SUMO (Simulator of Urban Mobility) traffic simulator to configurate realistic scenarios according to real patterns of mobility of the target city to optimize the Traffic Lights Plans (TLP) by elaborating open traffic data. HITUL system is structured in three layers, each one grouping close-related software components. First, a front-end server provides a single page application (SPA) exposing the traffic optimization dashboard, as well as the interfaces to take useful open data coming out from the software package. Also, the system has a back-end numerical server running data processing and optimization tools in	Environmental data	Presentation of different scenarios to enable traffic managers to choose the best TPL.	Case study of Malaga. Using HITUL, the decision maker could generate traffic light schedules to minimize waiting time, journey time, and emissions. The improvement achieved with HITUL in solution quality with respect to the expert's solution is remarkable.

	<p>a Java EE platform that provides a high level of availability, reliability, and scalability. Implemented algorithms for computing optimized TLPs are based on bio-inspired techniques and some multi-objective versions based on crowding and using numerical archives for non-dominated solutions whose core intelligence is regulated mainly by the Non-Dominated Sorting Genetic Algorithm (NSGA-II). Finally, the HITUL architecture involves a database server, comprising the data collections and the interfaces to manage them.</p>			
Alhussein M, 2017 [36]	<p>In this paper, sensors that can capture voice signals, including smart phones, voice recorders, and portable computers or tablets have been used. Voice signal is captured through sensors in smart homes. The system takes a voice signal as input, processes the signal on the cloud server to detect whether the signal is from a PD patient or from a healthy subject, sends the results to registered doctors for a proper prescription, and notifies the client about the results and prescription.</p>	Input from users	Automatic sending of the report with tone of voice abnormality to registered physicians.	<p>The aim is checking for a voice disorder for the early diagnosis of Parkinson's disease (PD). Two different databases were used for the experiments. Four different machine learning algorithms (classifiers) were investigated. In the experiments, the extreme learning machine (ELM) and the support vector machine (SVM) produced the best results, followed by the Gaussian mixture model (GMM) and the random forest tree (RFT) . The best PD detection accuracy was obtained by combining the two classifiers: ELM and SVM.</p>
Mora H, 2017 [28]	<p>Global Positioning System (GPS) - Radio. Frequency Identification (RFID) tags - Bluetooth Low Energy (Bluetooth LE—BLE) receiver. The Cloud Support Infrastructure is the centralized part of the system for the collection of all the individual locations and issues and computation for the generation of the Key Accessibility Indicators (KAIs) of the city area. Acquiring components include Near Field</p>	Input from users and open access maps of the city	The system provides decision makers different KAIs to plan urban actions and to measure their efficacy.	<p>The case study is the university of Alicante in Spain. The daily path of students and lecturers inside of the buildings (indoors) or across the campus (outdoors) has been analyzed. Different paths taken by people with and without disabilities to reach the same place or access the same building have been detected.</p>

	Communication (NFC), mobile device application, RFID/NFC/BLE Smart sensor network. When using the app, no personal data is needed, just the disability type of the user.			
Mihaita AS, 2018 [27]	FlexSim simulation model (STM1) can decrease the average travel-time during rush hours and increase the number of vehicles transiting the intersection every day. The evolutionary algorithm (EA) selects the best members of a population and uses them to recombine and perturb locally, in order to create subsequent populations until a predefined goal was reached.	Environmental data	Pareto fronts for all available traffic signal plans which have been simulated.	This paper proposed an urban traffic multi-objective optimization method for intersections belonging to a transforming neighbourhood from Nancy, France. Initially, the C129 traffic simulation model in FlexSim had been constructed using real-traffic data sets from the local traffic management center, which allowed researchers to obtain the objective criteria they want to optimize. Using evolutionary algorithms for the optimization process, the Pareto fronts for all available traffic signal plans which have been simulated have been obtained.
Zaheer T, 2019 [25]	Vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-pedestrian (V2P) communication. Wi-Fi Direct enabled Android-based smartphones have been used as embedded devices in vehicles, and a vehicular ad hoc network has been used to implement an intelligent transportation system.	Input from users and open access maps of the city	The system shows drivers different routes based on route length or traffic congestion in real time.	An intelligent transport (iNET) framework was proposed, mainly focused on developing countries, with the aim of facilitating drivers to make timely decisions in the absence of Internet connectivity and other RSUs to optimize traffic flows. To generate traffic patterns from the generator, traffic information of the twin metropolitan cities of Pakistan (Islamabad and Rawalpindi) were gathered.
Bardhan R, 2020 [33]	A Land Surface Temperature (LST) mapping of the area where the future smart city would be located has been elaborated, to help in the identification of heat stress. A computer-aided design (CAD) model of a chosen residential housing area within the to-be-built building stock in Amaravati smart city was generated. To study	Environmental data and open access maps of the city	The proposed framework could support policy decisions on energy infrastructure and urban planning under the influence of urbanisation-induced warming effects.	The paper describes a novel residential energy stress mitigation framework called REST to estimate warming climate-induced energy stress in residential buildings using a GIS-driven urban heat island and energy modelling approach. REST further estimates rooftop solar potential to enable solar photo-

	the formation of urban heat islands (UHI), an algorithm was developed in the Python v3.7.4 platform to simulate the UHI intensity. The estimated nocturnal rise in temperature from the UHI simulations was used to calculate the cooling demand of buildings in the study area, h. The mitigation strategy was envisioned around rooftop solar photovoltaics (PV) and optimisation of a peer-to-peer decentralised renewable power network.			voltaic (PV) based decentralised energy solutions and establish an optimised routine for peer-to-peer energy sharing at a neighbourhood scale. The to-be built smart city under study is called Amaravati. It is in the hot and humid Deccan region of India, which is prone to multiple heatwaves.
Jia J, 2020 [30]	RE-3DSG sensors consist of two parts: The net ecosystem service (Net ES) and green volume ratio (GVR), where Net ES provides a solution consisting of runoff control, air purification, cooling, carbon sequestration, noise reduction, and recreational area establishment, while GVR assesses the spatial structure of urban built environment plant clusters.	Environmental data	Ability to assist users (usually decision makers in government departments) to improve the decision-making efficiency and increase the satisfaction of residents with urban green spaces.	Multidimensional assessment model by using RE-3DSG sensors on Net ES and GVR for sustainable and smart cities. Specifically, it modifies the parameterization and visualization functions of the traditional technology and utilizes relevant data related to the actual experience of residents to conduct a 3D evaluation of the urban green space structure of a city, with the final results visualized. Using this model can reduce the gap between virtual simulation and actual conditions, obtain more accurate first-hand urban green space data, and thus support sustainable and smart city construction.
Morris E, 2020 [29]	Air SENSor for Chemicals in the Environment (AirSENCE) was designed for measurement of typical ambient air pollutants, i.e. NO ₂ , O ₃ , PM _{2.5} , and PM ₁₀ , as well as nitric oxide (NO), carbon monoxide (CO), sulphur dioxide (SO ₂), and carbon dioxide (CO ₂). Integrated metrics such as Air Quality Index (AQI) and Air Quality Health Index (AQHI) are also computed based on the user's geographic location.	Environmental data and input from users	The sensor reports an integrated measure of different air pollutants.	It has been deployed in Canada in cities of the Greater Toronto Area, e.g. the City of Oshawa, and one of the GTA satellite cities— a municipality of more than 720 thousand inhabitants in the Greater Toronto Area (GTA)— in order to augment the existing urban data network and study the impacts of traffic flow and land usage on air quality. The example of Oshawa showed that air monitoring data can readily supplement that

				of other widely used smart city sensors such as traffic counters.
Pala D, 2020 [32]	A deep neural network model was learned, with 23 layers, mostly convolutional layers with some max pooling layers. The Painters network computes a layer of 2048 latent variables before the final discrimination layer is implemented with a soft-max non-linear function. Therefore, using the software Orange and its Python pipeline, all image blocks with the Painters model were processed, thus obtaining a final data matrix of 2512 examples, with 2048 features. This neural network was selected after testing all those made available by Orange (six different CNNs with different structures, i.e., Inception v3, VGG-16, VGG-19, Painters, DeepLoc, Openface), using the t-SNE algorithm: this algorithm performs a dimensionality reduction, projecting multidimensional data onto a 2D space, grouping the observations based on their possible similarities in the original space. Each neural network was tested, and their capability of grouping together images with a high percentage of green color was measured. The results show that the Painters network was the best performing one.	Environmental and healthcare data	Derived clusters correlated with healthcare indicators useful to ease urban planning.	Implementation of a data analytic platform designed to provide public health decision makers with advanced approaches, to jointly analyze maps and geospatial information with healthcare and air pollution data. In this paper, a component of such platforms has been described, which couples deep learning analysis of urban geospatial images with healthcare indexes collected by the 500 Cities project. By applying a pre-learned deep Neural Network architecture, satellite images of New York City are analyzed and latent feature variables are extracted. These features are used to derive clusters, that are similar areas where similar interventions can be planned. Moreover, clusters are correlated with healthcare indicators by means of a multivariate classification model.
Nagarajan SM, 2021 [35]	Authors have proposed a patient-centric ecosystem which consists of multi-layer architecture such as fog computing, device, and cloud for handling the large complex data. Internet of Things (IoT) based FoG-assisted cloud network architecture that accumulates real-time health care data from patients via several medical IoT sensor networks, these data are analyzed	Healthcare data	Detection of emergency risk level of patient health.	IoT-based deep learning integrated healthcare systems were described, that detect emergency risk level of patient health from IoT data as well as medial health data by preserving the confidentiality and integrity of a patient's personal and medical health information. Moreover, deep learning-based hierarchical neural networks that

	using a deep learning algorithm deployed at a FoG-based Healthcare Platform.			acquire a fusion of sensor data and medical data after feature extraction, data pre-processing and feature selection for health condition prediction and classification was proposed.
Valinejadshoubi M, 2021 [34]	Integrated solution based on a Building Information Modeling (BIM) platform and Internet of Things (IoT). The designed prototype explores the integration of commercial BIM platforms with sensor data to create a self-updating BIM model to provide real-time thermal condition monitoring based on the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard within an office environment. The temperature and humidity values, measured by sensors, are sent to the MySQL database server. An integrated workflow was developed to compile, standardize, integrate, and visualize monitoring data in a BIM environment to facilitate interpretation, analysis, and monitoring data exchange.	Environmental data	Real-time thermal condition monitoring.	The developed system was able to detect the time and location of a case study office room experiencing the levels of thermal comfort/discomfort based on the targeted thresholds. In this case, thirteen levels of thermal discomfort cases, out of forty-nine data points during the test, were detected, and the developed system was also able to generate a trigger and transmit alarms to facility managers via their wireless devices in real-time. The fully automated system developed is expected to provide a robust and practical tool for reliable data collection, analysis, and visualization to help decision makers in making choices that maintain the thermal comfort level of occupants at a satisfactory level.

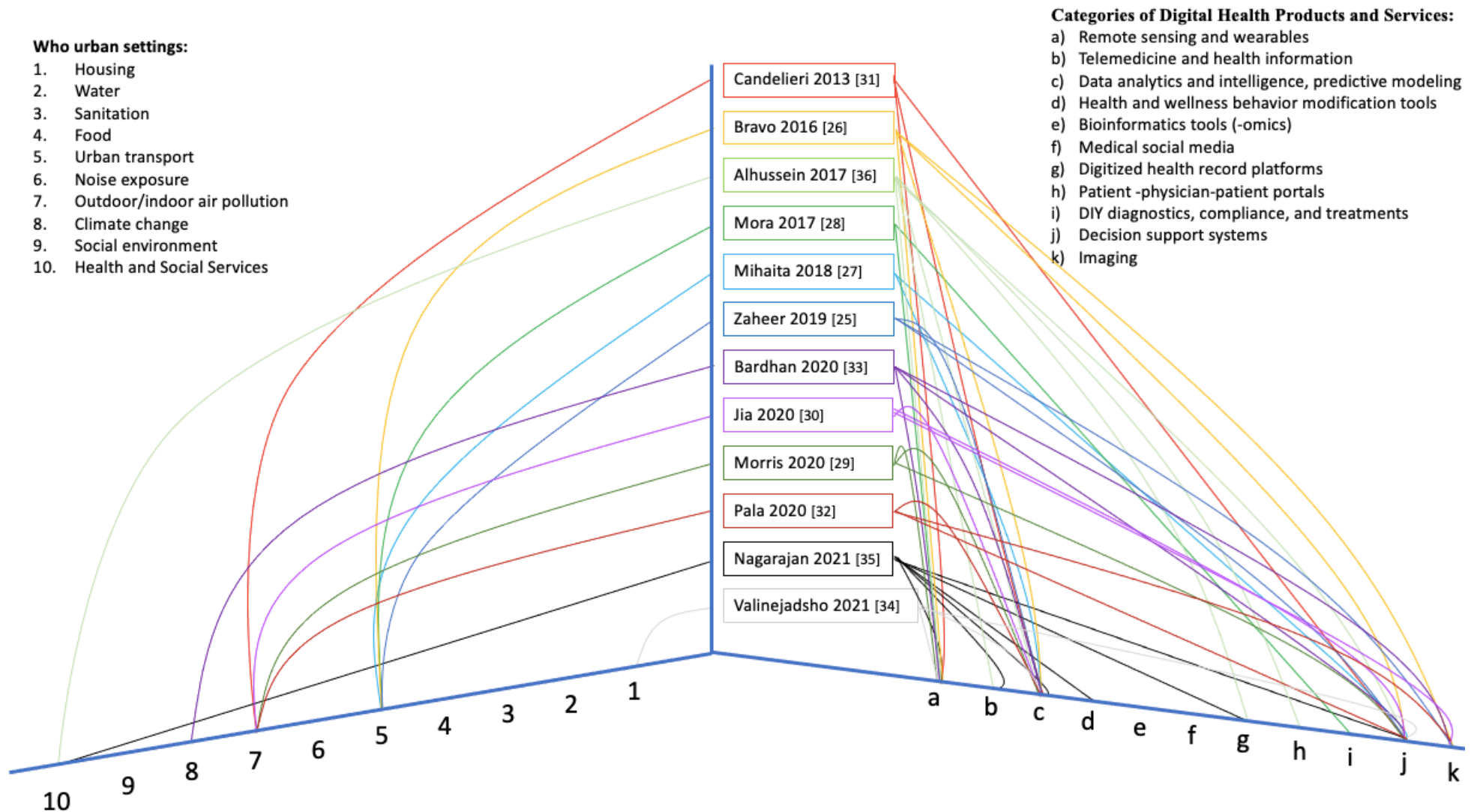


Figure S1: Graphical representations of results in terms of Urban setting and categories of technology used in included studies.