Expression of Interest

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1. Motivation

Nowadays, there are more than 43 billion devices connected to the Internet, generating, collecting and sharing data[1]. From them, 15.14 billion are connected IoT devices, and this figure is expected to double by 2030[2]. Although IoT devices are mainly used in industry, consumer segment represents the 60% of the total[3].

Moving computation to the origin of the data has arised concepts such as far edge, where data is analysed closer to it. However, processing still needs to be shiften form the original device to others with higher computation capabilities.

Pervasive computing, considered as the natural evolution of mobile computing, aims to keep this processing at device level to allow users improve their experience and even quality of life.

Connecting people and devices, allowing human interaction, only when needed, and consuming technology is creating a new era. Society 5.0, a Japanese initiative, is a good example on how technology is impacting on societies.
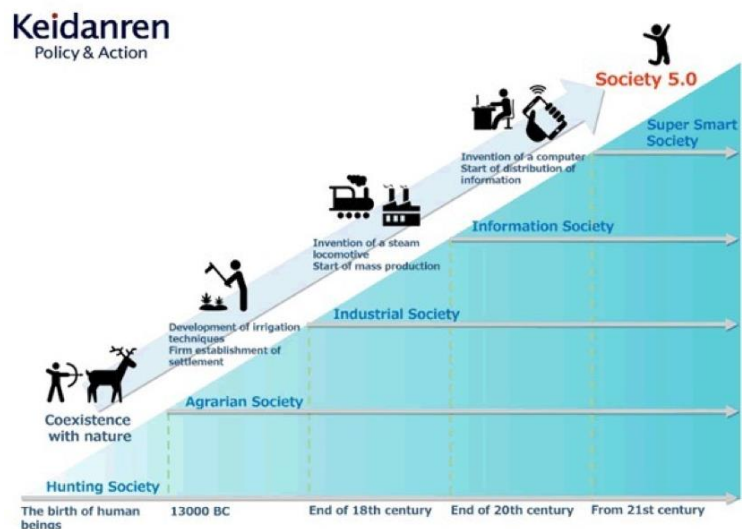
2. Current Status

Pervasive computing goes one step further of well-known ubiquitous computing, requiring less human interaction. Although in an ubiquitous environment there can be a higher amount of connected devices, data collection and processing still requires some human intervention. Opposite to this concept, pervasive computing relies on intelligent and self-adaptive environments able to understand user needs, based on data context and activities, and react accordingly.

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[1] https://www.forbes.com/sites/bernardmarr/2022/11/07/the-top-4-internet-of-things-trends-in-2023/
[2] https://explodingtopics.com/blog/number-of-iot-devices
[3] https://www.statista.com/statistics/1183457/iot-connected-devices-worldwide/

However, pervasive computing cannot be only applied to end users but to any type of industry where several IoT connected devices need to communicate, interact and execute actions to achieve a goal.

Technologies such as artificial intelligence, voice recognition, networking and, specially, security are basic for setting up a pervasive environment where dozens of devices can extract, collect and analyse data and perform the corresponding actions. However, this will be only possible when devices have a micro processor installed.

Current research topics focus on the Continuum, on the Edge or on IoT, however this trend means bringing edge computing even closer to IoT, embedding it in the IoT devices raising the concept of microedge (edge computation capabilities in a microprocessor installed in an IoT connected device).

3. Research Challenges

This new approach to computation at the edge of the network brings several challenges that need to be addressed:

- Trust models for pervasive networks. Taking into account that all devices are connected through the Internet, it is important to trust the data source.
- Embedded microprocessors (micro- and tiny-edge/AI). Reduced versions of AI/ML algorithms that can be executed in devices with fewer capabilities. As well as computation capabilities embedded in different types of devices.
- Ad-hoc devices clustering. Similar to the concept of swarm computing, where although all devices are connected to the same network, they will only intervene when they are necessary for executing an action. This is directly related to the scalability of the system.
- Embedded (and dedicated) networks. Available for the devices' clusters in order to secure all data transactions between the different devices.
- Decentralised management. Taking into account that none of the devices will take control over the actions performed within the cluster.
- Predictive behaviour. Twofold actions: on the one hand, the system will learnt from past experiences aiming to predict what a single user action requires from its side; while on the other hand, the system must be able to respond to different interactions such as touch a screen, voice signals, etc., depending on the device interface.

All of them must ensure to follow data sovereignty principles. While making sure all processing takes into account energy consumption or batteries' status.