Augmented Humanity

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Contributor: Graciela Guerrero

Augmented humanity is a human–computer integration technology that proposes to improve capacity and productivity by changing or increasing the normal ranges of human function, through the restoration or extension of human physical, intellectual and social capabilities.

augmented humanity   wearable computing   mixed reality   human–robot interaction

smart devices

1. Introduction

Humans are increasingly dependent on technology. Technology has changed not only humans' behavior and values but also the way they think, communicate and act [1]. However, recent scientific discoveries and inventions have demonstrated that technology is also beginning to modify human capabilities, pushing them beyond their natural limits [2][3][4]. With the advance of technology, the interaction between humans and machines has been "improved", "augmented" or even "redesigned" [5][6][7][8]. This has made it not only interesting and intriguing but also viable and arising as a serious concept of scientific research and development [9][10]. A term related to this technology advancement is Augmented Humanity (AH).

The term AH was coined in 2010 at the Internationale Funk Ausstellung conference [11][12], indicating that different devices which at first glance seem unconnected to each other will in the future offer a convergence between technologies and devices that aim to interact naturally with the user. The Isobar Trend Report [13] introduces AH as technologies that can work in harmony with humans in ways that enrich life, enhance the human experience and drive sustainable progress for the benefit of people, which will involve investing and engaging underserved audiences in the process. Working together, human and artificial agents must learn and bring these terms into close collaboration between human and artificial agents. These dilemmas are largely due to the differences between human and artificial capabilities and potentialities, and the resulting tensions in their collaboration [14][15][16]. Some researchers directly interchange the terms AH and augmented reality (AR). For instance, when AR is deeper and augments the human being, it is called an augmented human [17]. Another article exposes AR as a means to create an augmented human [18]. AH is a discipline that is linked to AR, but the difference between both is not clear [19]. However, these concepts can be clarified with the example of glasses, which can be AR or AH. When the glasses complement the view, then this will be AH; if the glasses have an external functionality, for example to perform a calculation, then it is AR.

Hence, the definition of AH is currently not concrete enough, because there are several "definitions" that are not interconnected one to another.

2. Augmented Humanity

2.1. Definitions of AH

The AH definitions that were obtained are shown in **Table 1**.

Table 1. Definitions of Augmented Humanity.

Article	Definition
[20]	Augmented Humanity is the improvement of traditional human–human and human–machine interaction by augmenting humans with portable technology and developing new user interfaces.
[21]	Computers augmenting humans enable instant information access. Yet, interactions between these two sides, the augmented human within an augmented world, are still different from human–human and from device–device interactions.
[22]	Augmented human is a human whose physical, intellectual and social ability are enhanced by the augmented/virtual reality and the smart ICT technology.
[23]	Google CEO, Eric Schmidt, has called this "augmented humanity", where networked devices "just work and understand autonomously" [11].
[24]	Human augmentation amplifies and enhances human ability to do work. Encompasses many technologies: prosthetics, orthotics and physically assistive devices that replace missing or lost functions; exoskeletons that extend physical abilities; collaborative systems that work alongside people to fill in and complement human abilities; and socially assistive robots that monitor and motivate human work and effort.
[25]	Advanced human augmentation suggests technologies that augment human actions, senses and cognition in new, as yet unexplored ways, in order to enhance human senses, to provide assistive augmentation and to create a seamless technology environment for human interaction.
[26]	An augmented human is a person who is able to use AR effectively to expand the physical, intellectual and social abilities of the user.
[27]	Augmented humanity refers to the digital administration of the world, where the human converges with computer electronic devices and instruments, generating a natural environment for the user, where even the user is not aware of the new technologies that he is using for himself.
[28]	Augmented human refers to a research direction of enhancing or augmenting human abilities by human–computer integration.
[29]	Augmented human introduces a fundamental paradigm shift in HCI: from human–computer interaction to human–computer integration, and abilities will be mutually connected through the networks (what we call IoA, or Internet of Abilities, as the next step of IoT, Internet of Things).

Article	**Definition**
[30]	Human augmentation is a deliberate act. It is a permanent or temporary bodily intervention that changes or augments otherwise normal ranges of human function.
[31]	Technologies that enhance human productivity and improve or restore capabilities of the human body or mind are an area of computing we refer to as human augmentation.
[32]	Augmenting human intellect and amplifying perception and cognition as various technologies designed to augment the human intellect and amplify human perception and cognition.
[33]	Human–computer integration (HInt) is considered a new paradigm with the key property that computers integrate closely with the user. Such integration occurs primarily at the individual level through sensory fusion, with computers providing information directly to the human senses rather than through symbolic representations and understanding the implicit and precognitive needs of the user through biosensitization. However, there is also the observation that this integration occurs at a social level, where the human being and the interface agents make a coordinated effort to achieve a common goal.
[34]	Human augmentation is an interdisciplinary field that addresses methods, technologies and their applications for enhancing sensing, action and/or cognitive abilities of a human. This is achieved through sensing and actuation technologies, fusion and fission of information and artificial intelligence methods.
[12]	AH involves augmenting humans with devices that can collect data from the individual and the individuals' environment and transmit this data to an external device or service.
[35]	Human augmentation is an approach to enhancing and empowering human functions with information technologies utilizing robotics and sensing devices.

2.2. New definition

Augmented humanity is a human–computer integration technology that proposes to improve capacity and productivity by changing or increasing the normal ranges of human function, through the restoration or extension of human physical, intellectual and social capabilities.

The justification of this new formal definition of AH is detailed next as regards the constituent parts of which it is made up:

- *Technology*: In accordance with [36], AH is described as a technology in relation to its "inputs" and "outputs", where the inputs of technology are knowledge, resources and labor, while the outputs are material culture and modification of the environment. Since technology is the immediate point of contact between people and environment, the consideration of the term technology acknowledges the limiting and shaping functions of the physical and social environment [37]. Furthermore, the content of technology can be conceived in terms of knowledge, applications or norms [37][38].

- *Human–computer integration*: The definition also expounds on the concept of human–computer integration, which is the symbiotic partnership or relationship in which humans and software give rise to patterns of behavior

that must be considered holistically [33][39].

- *Improvement of capacity and productivity*: Augmentation is the most common term in the interdisciplinary research community that focuses on interactive digital extensions of human capabilities [34]. The related concepts of augmented human and human 2.0 [40] refer to technologies that augment human productivity or capability or add to the human body or mind [41]. Human augmentation will serve the user by providing essential and timely information for common tasks [34] such as working, driving and so on.

- *Change or increase of normal ranges of human function*: Human augmentation products and/or applications can be made for anyone, from healthy users who wish to improve their human capabilities to users who face temporary or permanent disabilities, physical disabilities or hazardous situations requiring their use [42].

- When referring to AH as *improving the physical, intellectual and social capabilities* of human beings, we allude to all possibilities that are framed in each main component of AH. More concretely:

  - *Augmented physical capabilities* are achieved through the interpretation of the augmented senses and the actions they produce. Vision, taste, touch, smell and hearing can be physically augmented.

  - *Augmented intellectual capacities* are achieved through the acquisition of knowledge, cognitive processing and reasoning. Numerical aptitude, verbal comprehension, perceptual speed, inductive reasoning, deductive reasoning, spatial reasoning, abstract reasoning, memory, will and so on can be augmented intellectually.

  - *Augmented social skills* are considered through the interpretation of basic and complex social skills. Empathy, emotional intelligence, assertiveness, listening skills, ability to communicate emotions, ability to define a problem and evaluate solutions, negotiation, presenting oneself and many more can be socially augmented.

2.3. Areas of Knowledge Have Been Covered on the Theme of Augmented Humanity

In **Figure 1**, it can be seen that there are five relevant areas in which the selected research works are focused: computer science (91), engineering (58), robotics (40), automation and control system (15) and telecommunications (12).
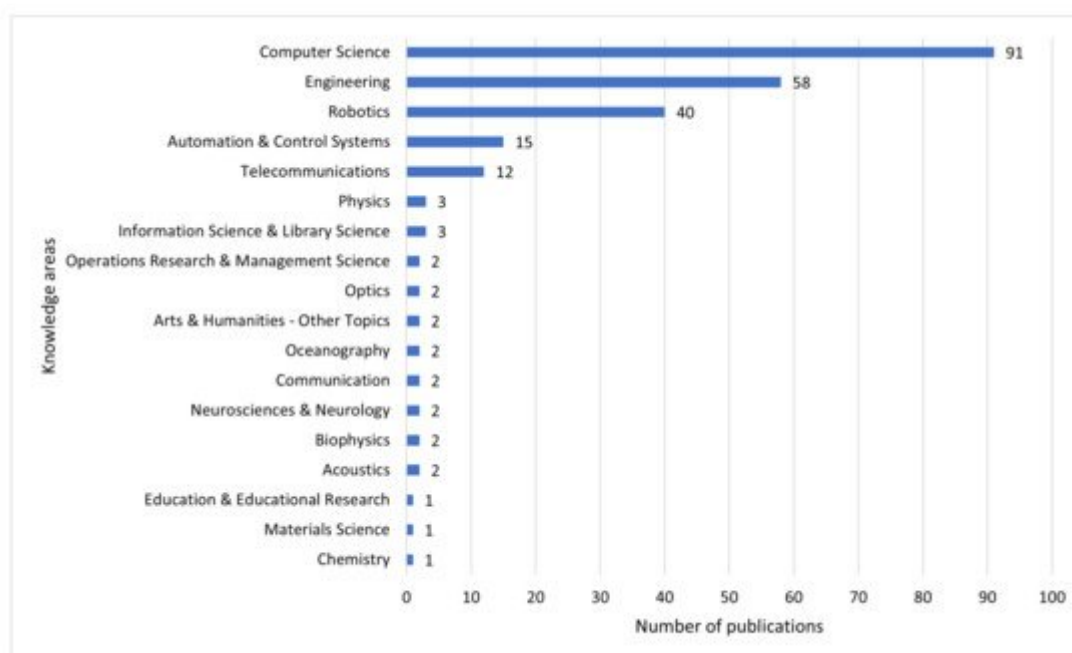
Figure 1. Web of Science research areas assigned to the 133 publications.

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