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Ambient Intelligent Computing in Health Care

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Abstract :- *Ambient intelligence Computing (AIC) is a multidisciplinary field of research includes: artificial intelligence technologies and human-centric computer interactions. Recently, AIC has been an efficient tool for the health care, e-health and telemedicine. This technology enables the elderly people and people with disabilities to improve their quality of life. This paper discusses the applications of AIC for healthcare for elderly people and people with disabilities. Challenges and current research areas are discussed as well.*

I.   INTRODUCTION

Recently, ICT produces a new computing paradigm known as ambient intelligence (AIC [1, 8]. AIC is characterize by invisible and embedded computational power in everyday usage, application and other common physical objects, including intelligent mobile and wearable devices [6, 9]. The concept of AIC provides a vision of the information society, where the emphasis is on greater user-friend lines, more efficient services support, user empowerment, and support for human interactions. People are surrounded by intelligent intuitive interfaces that are embedded in all kinds of objects and an environment that is capable of recognizing and responding to the presence of different individuals in a seamless ,unobtrusive(i.e., , many distributed devices are embedded in the environment , not intruding upon our consciousness unless we need them) and often invisible way.

AIC is anticipated to have a profound impact on the everyday life of people in the information society [3, 4, and 9]. A variety of new products and services will be made possible by the emerging technological environment, including home networking and automation, mobile health management, interpersonal communication, and personalized information services. Many of these applications and services are anticipated to address a wide variety of domains and tasks that critical for elderly people and people who are disabling. For example, in the health care domain, AIC technologies will have the potential to greatly compute to improve services for everyone .A sensors measuring heart rate, blood pressure, and other vital signs will provide the possibility of accurate and real-time control of the user's state of health, with mobile communication devices automatically dispatching emergency call if necessary. Portable positioning systems (e.g. GPS) can also help in identifying the location of a patient and various mobile communication devices can be used to obtain access to a patient's health–care record from any place and at any time. The deployment of telemedicine systems in AIC settings will also contribute to continue care and patient education, assist patients in taking medications, and improve healthcare delivery.

II.   MAIN CHARACTERISTICS OF AIC

- AIC refers to electronic environments that are sensitive and responsive to the presence of people.
- AIC aims to detect anomalous events from seemly disconnected ambient data that we take for granted.
- AIC is a new paradigm that enables a system to understand human states and feelings and to share this intimate information.
- AIC is a vision on the future of consumer electronics, computing and telecommunications that was originally developed in the late 1990s for the time frame 2010–2020 [2]. Figure 1 shows the time frame of

the AIC.
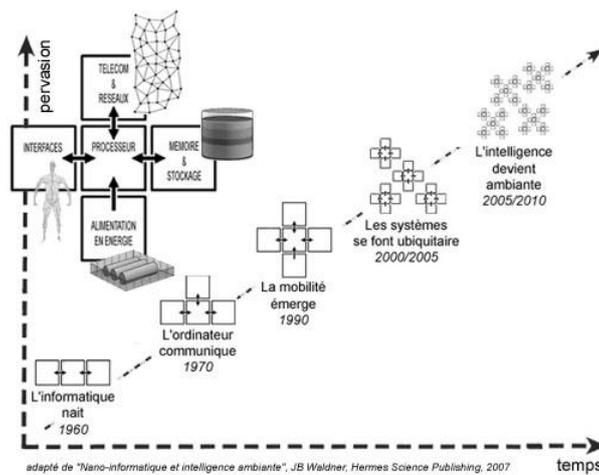
Figure 1: Timeframe 2010-2020 [2]

- AIC is made possible by the convergence of affordable sensors, embedded processors, and wireless ad-hoc networks.
- AIC paradigm builds upon ubiquitous computing and human-centric computer interaction design.
- In an ambient intelligence world (see figure 2), devices work in concert to support people in carrying out their everyday life activities and tasks in easy, natural way using information and intelligence that is hidden in the network connecting these devices [5].

Figure 2: Ambient Intelligent World [5]

III.   THE KEY TECHNOLOGIES OF AIC

AIC is characterized by systems and technologies that are: Embedded, Context Aware, Anticipatory, Adaptive, and Personalized. Figure 3 shows the AIC cycle. This cycle is composed of the following five phases: (a) Embedded; where many networked devices are integrated into the environment, (b) Context Aware; where devices can recognize situational context of the person, (c) Anticipatory; Anticipate your desires the personal desires without conscious mediation, (d) Adaptive; change in response to the person and (e) Personalized; tailored to the personal needs.
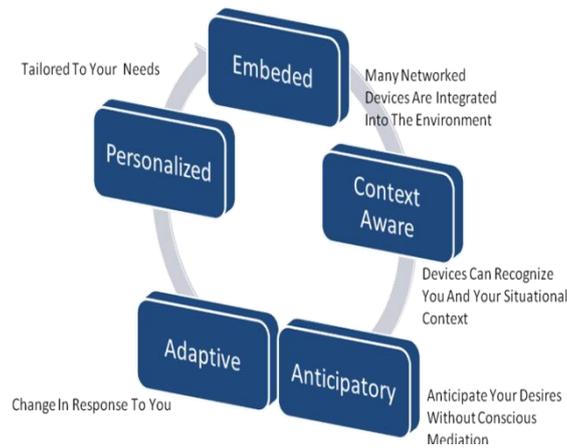
Figure 3: AIC Cycle

Figure 4 classifies the key technologies which cooperate to deliver AIC system. The main 5 classes of these technologies and their corresponding technologies are:

1. Human-centric computer interfaces
   (a) Intelligent agents.
   (b) Multi Model Interaction.
   (c) Context awareness.

2. Dynamic and massively distributed device networks
   (a) Service discovery.
   (b) Auto-configuration
   (c) End user programmable devices and systems

3. Unobtrusive hardware
   (a) Miniaturization
   (b) Nanotechnology
   (c) Smart devices
   (d) Sensors

4. Seamless mobile / fixed communication and computing infrastructure
   (a) Interoperability
   (b) Wire And Wireless Networks
   (c) Service Oriented Architecture
   (d) semantic web

5. Dependable and secure systems and devices
   (a) self-testing
   (b) self-repairing software
   (c) privacy ensuring technologies
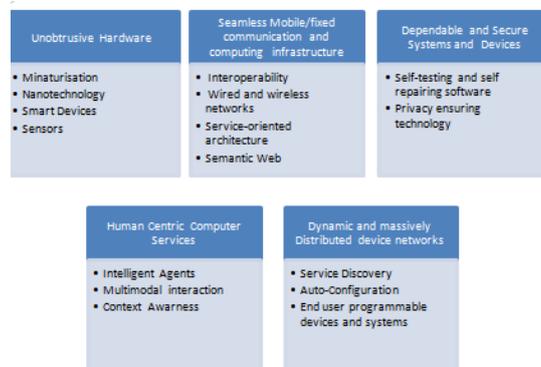
Figure 4: Key Technologies of AIC

Figures 5 and 6 show the main scientific disciplines and their related topics which contribute in building AIC system. The three main disciplines with their corresponding topics are:

1. Artificial Intelligence

(a) Expert Systems
(b) Computer Vision
(c) Natural Language Processing(NLP)
(d) Robotics
(e) Intelligent agents
(f) Data Mining and Knowledge Discovery (DM & KD)

2. Computational Intelligence
(g) Neural computing
(h) Genetic algorithms
(i) Decision trees
(j) Rough sets
(k) Fuzzy logic
(l) Case Based Reasoning (CBR)

3. Web Intelligence
(m) Web mining
(n) Web framing
(o) Web log mining
(p) Web information retrieval
(q) Web knowledge management
(r) Semantic web

Artificial Intelligence
• Expert Systems
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Web Intelligence
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• Web Log Mining
• Web Informational Retrival
• Web Knowledge Managment
• Semantic Web

Ambient Intelligence
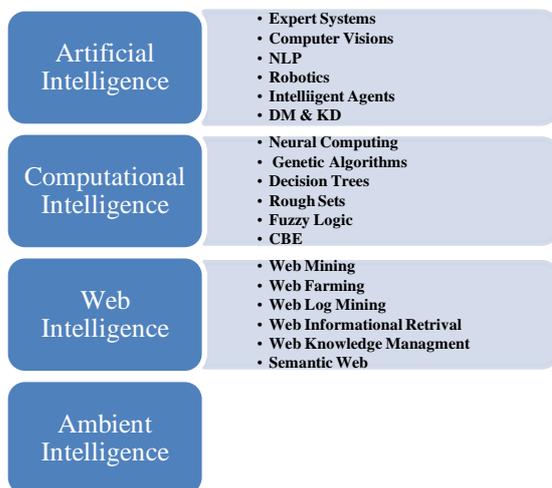
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Figure 5: AIC Scientific Disciplines and Communities from AI to AIC

Requirements Engineering
Software Quality
Digital Signal Processing
Software Quality
Human Computer Interaction
Usability Engineering
Artificial Intelligence
Social Sciences
Human Factor
Software Engineering
Machine Learning

Figure 6: AmI Disciplines

IV.   SOME EXAMPLES OF AIC FOR DISABILITIES

1. Neural computing to improve linguistic word predication. Word prediction is the most frequently used technique in writing systems designed to assist people with disabilities.
2. Vision-Based human computer Interfaces. Intelligent eye tracking systems to implement eye mouse to Provide computer access for people with severe disabilities.
3. Virtual reality technologies. Patients with disabilities can be trained with virtual reality systems to judge

architectural barriers and tackle environmental obstacles.
4. Accelerometer-based human computer interface for people with severe disabilities.
5. Mobile technologies for people with disability.

V.   APPLICATIONS OF AIC IN HEALTH CARE SECTOR

A variety of new products and services will be possible for elderly people and people who are disabled. E.g. home networking and automation, mobile health management, interpersonal communication and personalized information services.

Sensors measuring heart rate, blood pressure, and other vital signs will provide the possibilityof accurate andreal-time control of the user's state of health, with mobile communication devices automatically dispatching emergency call if necessary.

Portable positioning systems (e.g. GPS) can help in identifying the location of a patient, mobile communication devices can be used to obtain access to a patient's healthcare record from any place and at any time.

Telemedicine systems in AIC settings will contribute to continue care and patient education, assist patients in taking medications, and improve healthcare delivery.

VI.   EMERGING CHALLENGES OF AIC

- The distribution of interaction over devices and modalities.
- The balance between automation and adaptation and direct control.
- The identification of contextual dependencies among services.
- Health and safety issues.
- Privacy and security.
- Social issues.

VII.   THE SOCIAL AND POLITICAL ASPECTS OF AIC

The ISTAG advisory group suggests that the following characteristics will permit the societal acceptance of AIC:
(a) AIC should facilitate human contact.
(b) AIC should be orientated towards community and cultural enhancement.
(c) AIC should help to build knowledge and skills for work, better quality of work.
(d) AIC should inspire trust and confidence.
(e) AIC should be consistent with long term sustainability - personal, societal and environmental - and with life-long learning.
(f) AIC should be made easy to live with and controllable by ordinary people.

7.2 BUSINESS MODELS FOR AIC

The ISTAG group acknowledges the following entry points to AIC business landscape:
(a) Initial premium value niche markets in industrial, commercial or public applications where enhanced interfaces are needed to support human performance in fast moving or delicate situations.
(b) Start-up and spin-off opportunities from identifying potential service requirements and putting the services together that meet these new needs.
(c) High access-low entry cost based on a loss leadership model in order to create economies of scale (mass customization).
(d) Customer's attention economy as a basis for 'free' end-user services paid for by advertising or complementary services .
(e) Self-provision – based upon the network economies of very large user communities providing information at near zero cost.

VIII.   CONCLUSION

- Ambient intelligence computing is a new approach for developing an efficient assistive technology that increases and improves the functional capabilities of individuals with disabilities.
- Ambient intelligence paradigm yields smart technologies that enable the elderly people and people with disabilities to change and improve their quality of life, and overcome many barriers .
- Ambient intelligence computing offers a new way to use the medical devices at a distance for many health care activities, e.g home networking , mobile health management, interpersonal communication and personalized information services

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