Enhancing the life quality of elderly using Ambient Intelligent Technology (AmIT)

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Abstract

Ambient Intelligent technology (AmIT) is a new paradigm in information and communication technology ,ICT , aimed at empowering people's capabilities by the means of digital environments that are sensitive, adaptive, and responsive to human needs, habits, gestures, and emotions.AmIT is a multidisciplinary field of research, it's the convergence of electronic engineering, computer science, telecommunication, artificial intelligence and Social intelligence. Recently, AmIT has been an efficient tool for the healthcare, e-health and telemedicine. This technology enables the elderly people and people with disabilities to improve their quality of life. This paper discusses the role of AmIT in improving the life quality of elderly people. It presents a framework for enhancing the life quality of elderly using Ambient Intelligent Technology (AmIT)

Keywords: *Elderly Healthcare, ambient intelligence technology, Social Computing, Assistive technologies for elderly Artificial intelligence*, networking

1. Introduction

AmIT is an emerging discipline that brings intelligence to our life environments and makes those environments sensitive to us. It's a network of hidden intelligent interfaces that recognize our presence and utilize our environment to our needs [1, 2]. Artificial intelligence computing (AIC) is characterize by invisible and embedded computational power in everyday usage, application and other common physical objects, including intelligent mobile and wearable devices [3, 4]. 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. In AmI, the conventional input and output media no longer exist; rather the sensors and processors will be integrated into everyday objects, working together in harmony in order to support the inhabitants [5]. By relying on various artificial intelligence techniques, AmIT promises the successful interpretation of the wealth of contextual information obtained from such embedded sensors, and will adapt the environment to the user needs in a transparent and anticipatory manner.

Rest of the paper is organized as follows: section 2 discusses the multidisciplinary field of ambient intelligent technology. Section 3 presents the main features and characteristics of AmIT. Section 4 describes the AmIT technology and applications. Section 5 reviews the

Health care applications, and the benefits of both, body area networks (BANs) and dense/mesh sensor networks (MSN).Section 5 concludes the paper.

2. The Multidisciplinary field of Ambient Intelligent Technology

Figure 1 shows the disciplines and research areas of the AmIT based on our analysis of the published research during the last 10 years. From this figure it can be seen that the research in the field of consists of five main areas, names: (a) Electronic Engineering, (b) Computer and control sciences, (c) AI,(d)Telecommunications,(e)Social intelligence. In what follows, a brief account of the role of each discipline.

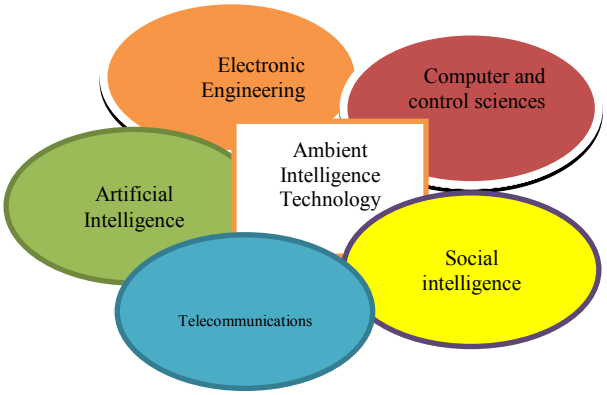

Figure1. AmIT Technologies and Scientific Disciplines

2.1 Artificial Intelligence (AI)

AI is considered the backbone of the AmIT. AI techniques offers robust tools and methodologies for the successful interpretation of the wealth of contextual information obtained from such embedded sensors, and will adapt the environment to the user needs in a transparent and anticipatory manner.AI has been mainly studied as computer based technologies. Various computational Models and knowledge based systems have been developed for automated reasoning and learning. AI is science and technology and is based on many disciplines such as: computer science, psychology, mathematics, biology, linguistics and engineering. The field covers the areas : Action and Perception (Vision, Robotics, Auditory Scene Analysis), automated reasoning, case based reasoning, cognitive modeling, connectionist models, constraint satisfaction, distributed AI, genetic algorithms, knowledge base technology, knowledge representation, learning, natural language, non-monotonic reasoning, planning, qualitative reasoning and diagnosis, reasoning under uncertainty and temporal reasoning.

2.2 Computer and Control Science

In this area, we are surrounded by various computing devices such as personal computers, smart phones, GPS, tablets, tele-operators ,data mining(DM) and knowledge discovery (KD),computer vision, expert systems ,robotics ,natural language processing(NLP), intelligent agents and various sensors such as RFID tags, infrared motion sensors, as well as biometric identification sensors. The widespread presence of such devices and sensors and accompanying services such as location service has already sparked the realization of ambient intelligence.

2.3 Electronic Engineering

In addition, recent electronic engineering advancements have made it possible for researchers to work on ambitious concepts such as smart homes, and to bring us one step closer to the full realization of ambient intelligence in our daily environments

2.4 Telecommunication

This Area will highlight and introduce the supporting infrastructure and technologies used in AmT systems in the context of health care domain. This includes (a)*Body Area Networks (BANs)* and (b)*Dense/Mesh Sensor Networks in Smart Homes*, as well as some recent trends in sensor technology, such as epidermal electronics and MEMS sensors, .Other examples also includes Signal processing, TLC networks ,Mobile networks.

2.5 social Intelligence

Social intelligence is engaged with the rest of the mentioned elements, where a combination of machine intelligence and human intelligence is needed for establishing social networks that contain communities of people, organizations, or other social entities

3. . Main Features of Ambient Intelligence Computing (AIC).

From the computational intelligence point of view, AIC builds on the following paradigms; Ubiquitous Computing, Ubiquitous Communication and Intelligent User Interfaces. **Ubiquitous Computing** means integration of microprocessors into everyday objects like furniture, clothing, white goods, toys, even paint. **Ubiquitous Communication** enables these objects to communicate with each other and the user by means of ad-hoc and wireless networking. **An Intelligent User Interface** enables the inhabitants of the AmI environment to control and interact with the environment in a natural (voice, gestures) and personalized way (preferences, context).The ideal ambient intelligent system is particularly identified by the following characteristics:

(a) **Distribution**: Non-central systems control and computation.
(b) **Ubiquity**: Surrounded by a multitude of interconnected embedded systems.
(c) **Intelligence** :Recognize the people that live in it, adapt themselves to them, learn from their behavior, and possibly show emotion, thus they are sensitive and responsive to the presence of people
(d) **Embedded:** Many invisible distributed devices throughout the environment.
(e) **Personalized:** That can be tailored towards your needs and can recognize you.
(f) **Adaptive:** That change in response to you and your environment. It adapts to the changing needs of individuals.
(g) **Anticipatory** : That Anticipate your desires as far as possible without conscious mediation
(h) **Context Aware:** It exploits the contextual and situational information.
(i) **Transparency:** It recedes into the background of our daily life in an unobtrusive way.

4. The AmIT Environment and Applications

AmIT is anticipated to have a profound impact on the everyday life of people in the information society [6, 7, 4]. 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. Figure 2 shows the various applications and environment of the AmT. In what follows, some of the AmT applications in different domains:

(a) **Smart Homes**: Ambient Intelligence is allowing the home itself to be intelligent and make decisions regarding its state and interactions with its residents.

(b) **Health Care sector applications**: Hospitals can increase the efficiency of their services by monitoring patient's health and its progress by performing automated analysis of recovering and diagnostic activities while they are in their rooms.

(c) **Transportation sector**: Public transport can benefit from extra technology including satellite services, GPS-based spatial location, vehicle identification, image processing and other technologies to make transport more flexible and hence more efficient and safe.

(d) **Education services**: Education-related institutions may use technology to create smart classrooms with smart equipment in order to enhance the learning process.

(e) **Emergency services**: Safety-related services like fire brigades can improve the reaction to a hazard by locating the place more efficiently and also by preparing the way to reach the place in connection with street services.

(f) **Production-oriented places**: Companies can use sensors to tag different products and track them along the production and commercialization processes. This allows identifying the product path from production to consumer and helps improving the process by providing valuable information for the company on how to react to favourable demand and unusual events like products that become unsuitable for sale

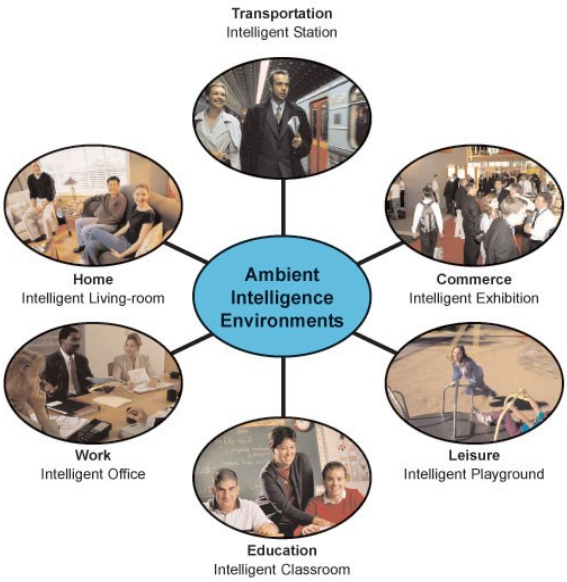

Figure 2: AmIT Environment and Applications

5 . Applications of AmIT in Healthcare and eHealth.

In the health care domain, AmTs 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 ambient computing settings will also contribute to continue care and patient education, assist patients in taking medications, and improve healthcare delivery.

In an ambient intelligence world (see figure 3), medical 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[8].In the following, a brief explanation for two examples namely (a)Body area networks (BANs),(b)Dense/Mesh sensor networks in smart homes.

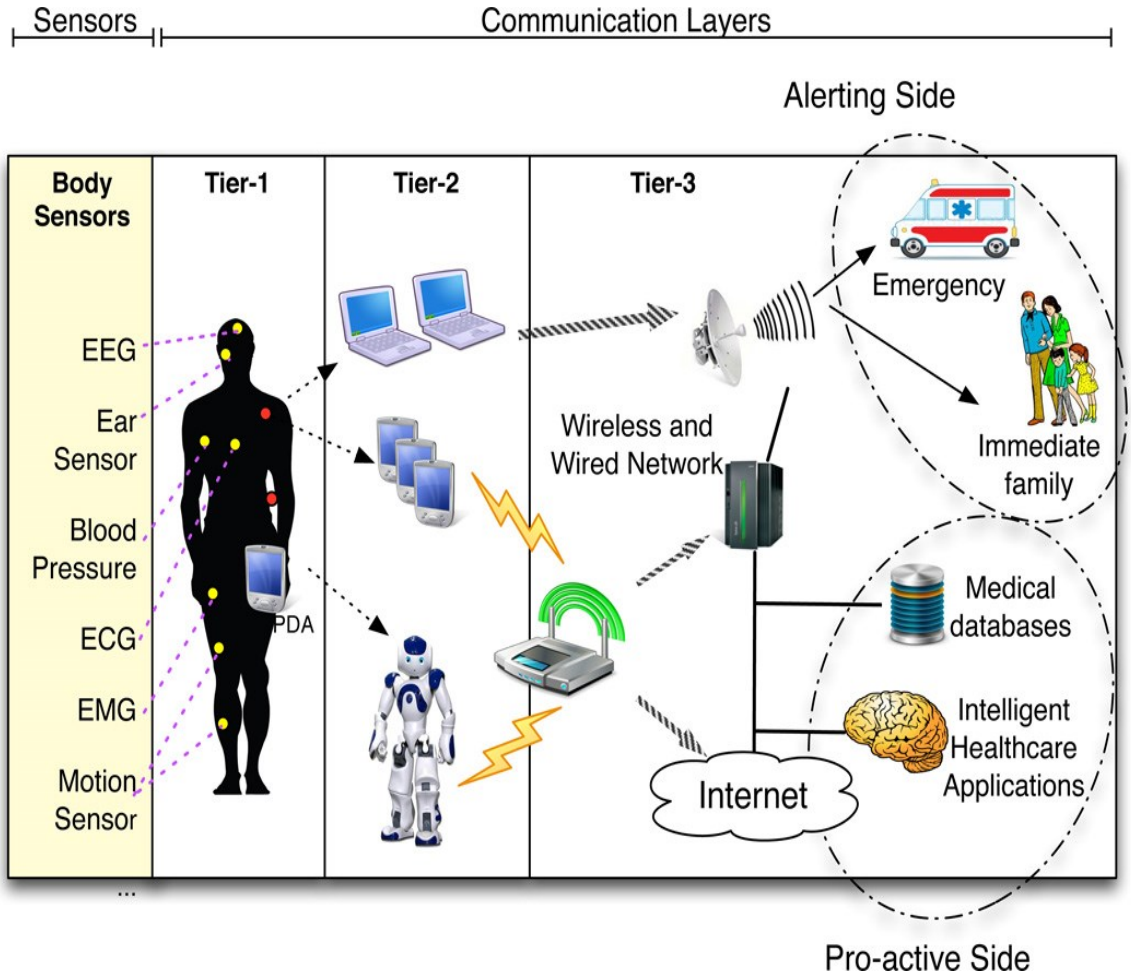

Figure 3: Ambient Intelligent in Health care and eHealth [8]

5.1 Body Area Networks (BANs)

The widespread use of wireless networks and the constant miniaturization of electrical devices has empowered the development of Body Area Networks (BANs) [9]. In a BAN, various sensors are attached on clothing or on the body or even implanted under the skin [10]. This new communication approach offers numerous new, practical and innovative applications for improving human health and the quality of life by continuously monitoring

health features such as heartbeat, body temperature, physical activity, blood pressure, ECG (electrocardiogram), EEG (electroencephalography) and EMG (electromyography). BANs provide a technological infrastructure for remotely streaming sensored data to a medical doctor's site for a real time diagnosis, to a medical database for record keeping, or to a corresponding technological equipment that, pro-actively and autonomously, can issue an emergency alert or intelligently manage this information for taking suitable actions and improving the quality of human life.

There are several benefits of using wireless BANs in health care applications; mainly *communication efficiency* and *cost-effectiveness*.

(a) Physiological signals obtained by body sensors can be effectively processed to obtain reliable and accurate physiological estimations. At the same time, the ultra-low power consumption provision of such sensors makes their batteries long-lasting.

(b) Moreover, with the increasing demand of body sensors in the consumer electronics market, more sensors will be mass-produced at a relatively low cost, especially for medical purposes.

(c) Another important benefit of BAN is their scalability and integration with other network infrastructure. BANs may interface with Wireless Sensor Networks (WSNs), radio frequency identification tags (RFID) [11], [12], Bluetooth, Bluetooth Low Energy (BLE, previously called WiBree) [13], video surveillance systems, wireless personal area network (WPAN), wireless local area networks (WLAN), internet, and cellular networks. All of these important benefits are opening and expanding new marketing opportunities for advanced consumer electronics in the field of ubiquitous computing for health care applications.

5.2 Dense/Mesh Sensor Networks in Smart Homes (MSNs)

Besides BAN, sensors can be embedded into our environments, resulting in intelligent and pro-active living environments capable of supporting and enhancing daily life, especially in case of elderly or individuals suffering from mental or motor deficiencies. In particular, *Wireless Mesh Sensor Networks(WMSNs)* could be used for designing unobtrusive, interconnected, adaptable, dynamic and intelligent environments where processors and sensors are embedded in everyday objects (clothes, household devices, furniture and so on) [14]. The sensors embedded into daily environments are usually called "ambient sensors" (as opposed to body sensors). The ambient sensors will collect various type of data to deduce the activities of inhabitants and to anticipate their needs in order to maximize their comfort and quality of life [15]. WMSNs are based on mesh networking topology, a type of networking where each node must not only capture and disseminate its own data, but also serve as a relay for other nodes. In other words, each sensor must collaborate to propagate the data in the network. The main benefits of WMSNs is their capability to be dynamically self-organized and self-configured, with the network automatically establishing and maintaining mesh connectivity among sensors [16]. WMSNs do not require centralized access points to mediate the wireless communication and they are particularly suitable to be used in complex and dynamic environments such as the living spaces [17].

6 .Summary and Conclusion

This paper presents a new framework for enhancing the life quality of elderly using Ambient Intelligent Technology (AmIT). Ambient Intelligence is a multidisciplinary field of research. It's the convergence of computer science, telecommunication, artificial intelligence , electronic engineering and Social intelligence. (AmIT) is new approach for efficient assistive technology for both elderly and disabled people.This paper has described the current state of the art in (AmIT) in the heath sector and projected future challenges and opportunities. Current research is marked by it's richness, with it's wide range of application domains and it's integration with numerous technologies and intelligent approaches. Opportunities abound, including new contributions to health care and support for elderly and disabled.

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