

Chapter 2

Healthcare Computer Reasoning Addressing Chronically III Societies Using IoT: Deep Learning AI to the Rescue of Home-Based Healthcare

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ABSTRACT

The authors present a proposal to develop intelligent assisted living environments for home based healthcare. These environments unite the chronical patient clinical history semantic representation with the ability of monitoring the living conditions and events recurring to a fully managed Semantic Web of Things (SWoT). Several levels of acquired knowledge and the case based reasoning that is possible by knowledge representation of the health-disease history and acquisition of the scientific evidence will deliver, through various voice based natural interfaces, the adequate support systems for disease auto management but prominently by activating the less differentiated caregiver for any specific need. With these capabilities at hand, home based healthcare providing becomes a viable possibility reducing the institutionalization needs. The resulting integrated healthcare framework will provide significant savings while improving the generality of health and satisfaction indicators.

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INTRODUCTION

The societal and epidemiological conditions in developed countries have progressed in such a way that the current Public Health Systems are not adequate any longer. There is an urgent need for systems to attend the chronic conditions instead of the acute events that the health systems were designed for in the middle of the XX century. In order to develop the requirements of these next generation public healthcare systems, formal ways of evaluation and scoring have to be set up that need to take advantage of some of the emerging technological breakthroughs at hand. Among these we aimed our work at joining the capabilities of having computable extended health/disease process knowledge enriched by IoT enabled ambient assisted living to acquire large numbers of health related events at population scale. Two sections in this paper are related to the different aspects of this question. First the Clinical Knowledge representation for reasoning and acquisition based in NLP (Natural Language Processing) and second the several questions that need to be addressed when applying the IoT and SWoT (Semantic Web of Things) in the healthcare process and the public system. Regarding the Clinical KR, we found that the problem known as “Knowledge Acquisition Bottleneck” (Wong, Liu, & Bennamoun, 2012) is currently the major obstacle for the development of adequate representations of medical knowledge computable representations, namely ontologies in the specific domain and in particular in the healthcare sub domain. Trying to devise a valid solution to that problem in order to enable clinical automatic reasoning either in a local, distributed or Semantic Web fashion, different sub problems had to be addressed and solutions found are proposed and summarized in “Our Solution” section.

The particular solution illustrated here is the extension of the usual DRS (Discourse Representation Structure) that usually handles single texts and our proposal that we named CIDERS (Clinical Integrated Discourse Enhanced Representation Structure) which has the extended capability of representing the whole discourse of a patient’s clinical history.

First of all, we introduce the scientific question of overcoming the KAB problem and explain why it is so hard to overcome.

Next the solution proposed is detailed in its various problems, and pragmatic approaches taken for the problem’s different facets.

The fourth section briefly explains the rationale behind CIDERS and why it may be a natural extension of the application of ACE tools in our work.

In the fifth section, we present the results obtained so far and explain the promising applicability to different clinical realities with expectable similar results.

We develop then the second issue addressed in this paper that is the utilization of the IoT related technologies in Ambient Assisted Living, with all the underlying issues and possible problems that have to be circumvented and propose ways of pragmatically handle them when needed and possible. We introduce the notions of emerging Intelligent Homes (vs. Smart Homes), and finally in the last section some conclusions are drawn and summarized from the various sections of the present paper.

NOMENCLATURE

AAL: Ambient Assisted Living

ACE: Attempto Controlled English

AI: Artificial Intelligence

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