Comparison of Pervasive Home based Health Care Systems under E-Health Perspectives

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ABSTRACT
Today’s, advanced Information and Communication Technologies (ICT) impress all of health perspectives. One of the human processes is body health and using e-health to help the health of individuals in human societies. ICT has high performance to support patients increasingly by means of new modern methods such as Multi Agent Systems (MASs). The agent based systems present new techniques to resolve human problems and implementing of them with software systems. In this paper, we introduce non-critical systems. The main characteristic of these systems are empathic on the remote healthcare as pervasively. We evaluate mobile multi agent based distributed information platforms for pervasive home healthcare monitoring as well as e-health security mechanisms in Java Agent Development Environment (JADE). Finally, we discuss about implemented e-health systems in Iran and their executive processes currently.

Keywords

INTRODUCTION
Nowadays, with advances in science and technology, it has been new methods to solve complex problems that face to human health based on electronically medical systems. In the recent years, pay more attentions to create and using these systems to patient’s treatment. MASs is new modern method to implement efficient medical systems. MASs are extremely important to generating medical health care systems electronically because of unique features e.g. parallel operations, ability to collect data from environments in real time processing automatically and autonomously and etc [1].

These systems are designed to improve lives of peoples, creating simple and impressive ways to prevent an emergency situation in treated patients [2]. As this regard, effective usage of communication technologies to enhance public health and patient’s treatment is too notable.

In order to electronically medical improvements, it has been considered e-health which means internet based support of various types of medical information, products, technologies and medical services [3, 4]. Using intelligent agents as an efficient manner to increase the performance of automated medical systems in the field of information technology with features such as scalability, reliability, ability to it reconfiguration, autonomously functions and etc. among of other characteristics of active agents in medical care, support synchronous/asynchronous form of communication technologies and cooperation with each other, implementation of medical services based on patient needs, increasing control medical records by physicians are significant.

The role of internet in agents based systems [5, 6], wireless sensor networks [7, 8], mobile services and other communication services is greatly notable. Wireless sensor networks have many applications in medical health care, emergency cases, security, industrial automation, earthquake detection and aeronautics and many more. Medical information and communication systems collect information in the field of medical care, clinical messaging, engage nurses, medical records, and benefit of them called telemedicine. Telemedicine refer to using telecommunication and information technologies to supply clinical health care at a distance and in time [9] are classified into three main parts are store and forward, remote monitoring and interactive services. In the home based health care systems, systems try to track and focus on in-home care operations such as designing monitoring systems, emergency alarms and etc. thus with designing and generating electronically medical systems many problems and issues to be solved within in time and without an place and time restrictions.

This papers deals with home e-health care systems based on MASs. The rest of the paper is organized as follows. We
introduce to e-health principles and aims and scopes of medical systems electronically. Then, we consider the MASs, previous related works and applications of them in the medical domain. Another section is discussion about home based health care systems which implemented electronically. In the subsection of this section, we evaluate and review the home based healthcare systems and so we reviewed discussion and the conclusion of this paper.

E-HEALTH

E-Health is new emerging science of combining medical informatics, public health which will be promoted through the internet and related technologies [10]. The term e-health or electronic health is the electronic health means different interpretations and meanings are in the IT fields. E-health can sense the use of electronic technology in the health, medical care, public health and etc. using e-health technologies in medicine and telemedicine [11] in order to practice medicine, public health and medical care of people in human society [3]. By means of electronic ICT in the health sector, everything from transfer digital data from purchase orders, reports, laboratory tests, medical history and insurance premium is possible with internet based platforms such as JAVA Agent Development Environment (JADE) [9]. In the other hand, e-health, health-related exchanges of electronically medical records that can be performed via different organizations, although a physician or health care constitute their different paths [10, 12] such as care of people with diabetes [13] or Alzheimer’s [14] disease and so on.

Many examples of the successful of implementations of an electronic health information network that contain electronic medical records (EMR), telecom services, medical monitoring systems such as [15, 16, and 17], mobile medical portals and etc [11]. It is mentioned that medical care can be provided in health centers, applied health services to increasing awareness by informing the public e-health via audio and visual media services for specialized medical testing, periodically check-ups to ensure the health, e-health books and so on.

MULTI AGENT SYSTEMS

Agent is a computer program that is able to perform automatic and independent functions from its owner or user. The main feature about the agent is their autonomy and they able to act independently and have control over their internal states [1, 18 and 19]. MASs are new methods for solving and implementation computerized software systems in which the agents is collection of software classes factually. These agents can be received data from different parts of the system autonomously and asynchronously as well as decide about them. Decision procedures in the agent based systems are by means of the data mining and machine learning algorithms [11]. The agents have many applications within high performance in the wide areas of medical that can be able to transfer distributed information such as case history as EMR in the hospitals, clinics, surgery centers in order to achieve remedy and treatment [15].

In recent years, many studies have been done in this scope. For instance, Haigh et al, [20] presented an open agent architecture for assisting elder independence which is a MASs that incorporates a unified sensing model, probabilistically derived situation awareness, hierarchical task network response planning. The proposed model act as real-time selection control, complex coordination within machine learning techniques to decision support. Daknou et al [21] proposed a tool to assist decision-making process for medical care of patients at the emergency departments within rapid access to patient medical records, integration of care’s protocols and assure knowledge of the quantity and the quality of medical activities. Su and Wu [11] presented JADE implemented agent based platform for pervasive medical care monitoring which is able to aware the responsible care, provider of abnormality automatically, offer distance medical advice and perform continuous health monitoring and reduce caregiver burden. The proposed system composed of six agents which are user agent, source agent, physician agent, diagnostic agent, knowledge based data server agent, external services agent e.g. vital sign monitor. As a result, this system is able relieve hospital personal from time consuming task of constant data monitoring and also able to provide patients a mobile, ubiquitous and personalized e-health care.

Home based health care systems

Health care implicate to the all kinds of activities for disease presentation, treatment and recovery processes. The medical and health activities by various medical organizations, academic institutions and other professionals to raise awareness, diagnosis and treatment are in [2, 3, 9, 11 and 15]. Medical care systems in homes or home based medical care systems are based on MASs in order to design monitoring systems as distributed are applied with alarm in emergency times. These systems emphasize to care of patients at their homes. At these types of systems, socio-medical care has been considered [13]. Improvement in patient care through the management of distributed software using smart agents, remote medical care for the elderly or chronically ill in the hospital is possible by monitoring and collecting, compiling and organizing medical knowledge available on the internet [3]. In the follows, we compare and evaluate four agent based medical systems with home approach to care and assist of patients at home with great potential to transform the process, and possibly even the outcomes. The systems are Tele-monitoring of patients at home with software agent approach [15], home care system [18], monitoring Alzheimer patients [2], and heart failure management in a home care environments [22] are detailed as follows:

A. Home based Tele-monitoring of patients System

Agent based Tele-monitoring system is a part of a great research project on Health Smart homes (HSH) to care of patient remotely in the clinical centers at the Grenoble in France [15]. Smart home system for health care of patient at smart homes is shown in the fig 1:
Designing and creation of this medical system remotely possible in two network levels: home level and community level. Agents applied in this system are explained in the Table 1.

### TABLE 1: AGENTS IN THE TELEMONITORING SYSTEM

<table>
<thead>
<tr>
<th>Agent Name</th>
<th>Device</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor Agent</td>
<td>Sensor medical devices</td>
<td>Calculating output data from physical sensors and local parameters such as transformation rates and formats</td>
</tr>
<tr>
<td>MeDiv Agent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAN-Agent</td>
<td>Local Area Network</td>
<td>Network and Sensor messages management</td>
</tr>
<tr>
<td>Home Server Agent</td>
<td>Home Computer</td>
<td>Analysis of data to decision making, alarm and saving local information</td>
</tr>
<tr>
<td>Scenario Recognizer Agent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main Server Agent</td>
<td>Remote server</td>
<td>Data warehousing, user management and machine learning</td>
</tr>
<tr>
<td>Client Agent</td>
<td>Careers’ access</td>
<td>Tele-monitoring, response to alarms, access to database and processing personal data</td>
</tr>
</tbody>
</table>

### B. HOME CARE SYSTEM

The terms Home Care (HoCa) [18] refer to all kind of own care in the home environment. The services of the presented system in the home have been performed by combining intelligent agents, identification and localization of technology, wireless networks and mobile devices.
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Fig 3. Structure of Alzheimer’s patient care system [2]

ALZ-MAS structure has five agents which each of them have special roles. The problem needs include patient personal information and their manner (monitoring, place, daily tasks and abnormalities), physicians that treat the patients and nurse program and etc with detailed in [2].

D. HEART FAILURE MANAGEMENT SYSTEM

Today, heart Failure (HF) is the most common cause of death in the world. Management costs include hospitalization, outpatient surgery costs and visiting HF patients are too high. The main aim of MASs is home based care from patients with HF, controlling their health conditions, monitoring and educational services to the chronic patients via communicational software platforms in order to manage HF diseases. The proposed system [22] uses home care telemedicine system and calling with medical centers perform care of patients. The architecture of agent based HF management system is shown in the figure 4.

--Access to medical information, monitoring patient’s condition in real-time
--Processing of medical information and interpreting patient data
--Reasoning, processing methods in order to evaluate the results
--Communicating between agents for collaboration and knowledge sharing
--Negotiating for specific operating decisions and assessing the results obtained from production and general information about the patient’s condition
--Learning methods to increase the capabilities and efficiency of the system of reasoning agents.

SECURITY MECHANISMS IN E-HEALTH SYSTEMS

JADE platform [9] uses JADE-S security methods to providing safety and trusted communications between agents’ interactions. In order to find out the role of information security in critical information transformation (which deals with the lives of peoples) in the following three concepts is essential to redefine [19]:

--Confidentiality: ensure that only those who are permitted to have access to information.
--Integrity: ensure that data cannot be changed; these changes include adding, deleting and removing the palace of data.
--Authentication: refers to ID that is a link between information and its sender.
--Non-repudiation: it prevents the negative parts of some previous commitments or actions of agents.

Because of autonomously agents, these characteristics are important and critical in design on agent based systems in medical domains. The agent based systems without any security mechanisms cannot be used in an open environment like internet. When critical medical data are transferred via internet, if they don’t comply, agents simply fail in their data communications and authentications. JADE-S is a plug-in of JADE that allow to creating some of security features to the agent based system in the development time. Thus, these systems can be used in the real environments with critical performances. The java security model based system provides the following benefits to MASs [19]:

--Java Authentication and Authorization Service (JAAS): that identifies permissions for operations on a predetermined set of classes, libraries and objects.
--Java Cryptography Extension (JCE): implements set of functions that allow to the developer to create and manage key and uses encryption algorithms.
--Java Secure Socket Extension (JSSE): that allow to changing in the critical information in the network by means of secure data transmission (SSL) protocol.

**DISCUSSION**

Until the last years, medical records of patients have been completed by physicians and medical teams, but today’s, the creation of electronic health records is accessible to all doctors have a functional plan in some hospitals in the number of regions in Iran. Electronic prescription and taking online visit times are other functional plans to increasing public health and human being in the society and preventing losses of time, and high performance in medical services in the least possible time. These are impossible in the past without digital and communication technologies. With creation these approaches in the internet based platforms; we can prevent the results of incorrect diagnosis of outpatients or chronically patients or even peoples need to prompt diagnosis or surgery.

Also, these systems help to preventing the dangerous consequences of the damage that can be with life and health care handled. They help eliminate distance barriers and can improve access to medical services that would often not be consistently available in distant rural communities [19]. They are also applied to support lives in emergency times and critical care. These technologies permit communications between patient and medical staff with both convenience and fidelity, as well as the medical transformation, imaging and health informatics and data from one site to clients and vice versa.

Agents due to the unique operating characteristics of the discovery, extraction, interpretation and verification of data led to increasing efficiency, flexibility and simplicity of systems are designed. Electronic medical systems are able to implement in the various software platforms in which they have ability to agent based software creation. These systems depend on the application type categorize in the non-critical systems. The home based health care systems as mentioned above located in the non-critical systems. Using data mining techniques [24] like artificial neural networks, Case Base Reasoning, Decision Tress, Bayesian Networks and etc. are very extremely and greatly significant in order to analysis, interpret and critical decision making in the hospitals, clinics and emergency departments.

As a result, we recommend to increasing scalability of home based health care systems over national and international levels as well as real-time control of operations in the medical internet based systems Alpha.

**REFERENCES**


