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Implementing Requirement for Hospital Management System using Multi-agent

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Abstract— The problem of workflow in hospital management is characterized by high uncertainty and dynamics in patient treatment. Additional complexity in the planning and executing processes is caused due to interdependencies of autonomous and administratively distinct units which are involved in the treatment of a patient. Besides it a HMS should be able to respond to evolving requirements. Unfortunately, a HMS developed using conventional software development practices may not meet this requirement as it may need system reengineering. An agent computing is a network of work station is powerful paradigm for building distributed application. An intelligent agent based HMS can adapt to such situations without system reengineering. In this paper we implement the application which improves the quality and accuracy of hospital management system.

Index Terms— Helth-care management, Multi-agent system, Requirement engineering,

1 Introduction

Hospitals are service providers with the primary aim to improve the health state of their patients, where the treatment of the patients is the main value-adding-process in hospitals [1][3]. Multi-Agent Systems (MAS) are proving a popular approach for the representation of complex computer systems. Hospitals consist of several autonomous, administratively distinct wards and ancillary units [5][10][12]. During hospitalization, the patients reside at the wards and visit the ancillary units for treatments according to their individual disease.

During the requirement gathering in HMS different – different aspect we analysed and various Healthcare models are primarily used to model the healthcare systems. It can be used to analyze the efficient usage of the resources in the healthcare system to provide quality healthcare service to the patients. The healthcare models can be used to identify disease transmission vectors at an early stage and thereby reduce the morality rate. The many emerging approaches and tools for Agent Oriented Software Engineering (AOSE) assist the generation of MAS models, enabling the translation of specifications to program code, but there still remains a gap between abstract initial requirements.

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The patient scheduling is concerned with the (optimal) assignment of medical tasks for the patients to the (scarce) hospital resources [11]. However, hospital patient scheduling is confronted with such a high degree of uncertainty that Schlüchtermann and Gierl [3][9] assess a short-time planning horizon of only one day whereas, for manufacturing control, Wöhe [5] assumes a short-time planning horizon of one to two weeks. In hospital patient scheduling, the patients arrive continuously at the hospital and the necessary medical treatments are often not completely determined at the beginning of the treatment process. Moreover, the new findings during diagnostic examinations change the (medical) priority of the patients, invoke additional treatments or examinations, or make other medical actions obsolete [22]. Furthermore, the durations of treatments and examinations are stochastic [1][23][29]. Finally, complications and arrivals of emergency patients which are in urgent need for treatment result in schedule disturbances. Because the ancillary units only have a local view and can not consider the complete pathway of the patients, no interunit process optimization is possible (i.e., the medical tasks for the patients cannot be scheduled and coordinated in an efficient manner). This causes undesired idle times as well as overtime hours for the hospital resources and extended patient stay times.

Concerning such real-world scheduling problems, classical AI and OR-based methods are often either too limited in expressive power regarding the representation of real world problems or lead to intractable problems with formalisms failing to solve real-sized problems in a timely fashion [10][1][3]. These approaches lack properties like flexibility, adaptivity, and reactivity, being based on methods that neglect dynamic changes and disturbances during a fixed planning period.

Multi-agent systems (MAS) are a promising approach to overcome such restrictions by providing properties like autonomy, reactivity and proactivity [5][6]. MAS are supposed to be suitable for real-world problems that have a special need for flexibility and adaptivity to dynamic changes and that have a decentralized planning structure. Meanwhile, different multi-agent systems have been designed that address problems of dynamic environments and disturbances in scheduling problems. Liu and Sycara [8] developed a MAS to solve job-shop scheduling problems, requiring real-time scheduling and execution. They decomposed the job-shop scheduling problem and distributed it on job-agents and resource-agents where each agent solves its sub-task. The coordination of the partial solutions is provided by constraint partition & coordinated reaction. Each agent communicates its results to affected agents and reacts to violations of restrictions.

Decker and Li [4] [5] modeled a MAS for hospital patient scheduling with complex medical procedures. They took a function-centered view and modeled nursing wards as autonomous agents. They developed a generalized partial global planning (GPGP) approach as a constraint-based coordination mechanism. It is constructed to avoid resource conflicts and patients are treated as exclusive resources that are handled by a special mechanism.

1.1 Agent-Based Models

Agent-Based Models (ABM) provide a powerful simulation technique to model the spread of epidemics. Agent-based modeling proceeds from the bottom-up approach. A system is modeled as a collection of agents, their interactions and behaviors. Agents are autonomous decision-making entities which can assess a situation and can make decisions based on the environment [5,11]. Agents can be reactive, proactive, social, truthful, and benevolent. Agents can act on their own without the intervention of the human agents [2]. Each individual agent is modelled separately and they are grouped together to form a system. Agent-based modelling find strem endous use in simulating the various flows like traffic flows, customer flows in a market , the organizational risks, epidemiological modelling [5].The major advantages of using ABM are that it is flexible and it provides a natural description of the system. It captures the interactions among the individuals [1].

ABM has the disadvantage that ABM has to be built for a specific purpose. ABM looks at a system from the level of its constituent units. Trying to model a large system using ABM would be time-consuming and would be very computation-intensive [11].

ABM can be used to model the emergency department. It can be used to model the efficient scheduling of the physicians. The efficient scheduling of the physicians would help in reducing the waiting time of the patients. Reduction in the waiting time of patients would in turn reduce the chances of infection spread from an infected individual to an uninfected person.[7-8]. ABM can be used to improve the quality of health care provided to the patients [6]. ABM can be used for modeling the spread of various epidemics and pandemics [9]. ABM can be applied at a community level as well as an institutional level. At an institutional level ABM is used to model the hospital emergency department [11].

ABM provides a natural and realistic description of the system. Since ABM incorporates agents, the dynamic interactions between the individuals can be realistically represented. ABM can be made flexible to add random agents into the system. Due to the dynamic interactions that can be represented by ABM, the spread of contagious diseases can be realistically represented. The realistic presentation of the system using ABM enables the analyst to study the transmission of contagious diseases and epidemics in a very effective and simple manner. The analyst gets a very detailed description of the system which proves to be useful in taking the preventive measure. The effect of the disease spread can be studied to find the effective methods to control the transmission of disease.

2 Specifics of the health care domain

Health care is characterized by special challenges regarding information logistics. For the further discussion, we concentrate on hospital information systems. Hospitals are usually divided into several functional areas. These are either autonomous or are allocated to a certain department. In the former case, hospitals make use of the centralization of services which are available to other departments. There are clear advantages of this organization as facilities can be shared among several entities and used efficiently. The central provision of services demands an all-embracing planning mechanism which takes into account competing requests from different departments. Up to now, these planning processes were usually performed manually, i.e. without IT-support. This leads to considerable organizational overhead.

Usually the treatment process is initially not determined in terms of treatment steps. This is due to the fact, that the diagnosis is originally unknown, but is elaborated during

the hospital stay. Furthermore, undeterminable and emergency situations occur and disturbe the regular treatment processes.
The cooperation, communication and coordination of medical personnel are not generally supported through information systems. The interconnectedness of treatment processes and their necessary logistics cycles cause interdependencies between these processes. The result is the need to resolve conflicts that are due to tight resources or contradictory goals (Kirn, Heine, Petsch, Puppe, Kluegl and Herrler, 2000).

2.1 Suitability of multi-agent systems

Currently available hospital information systems are not capable of providing adequate solutions to the described problems (Paulussen et al., 2003). Agent-based software systems, however, seem to provide valuable solutions. Software agents are capable of handling automatic negotiations. Using this mechanism, the planning of resource assignments can be supported by mapping principles of market economy to requirements in health care. Agent-based systems are an adequate means for implementing complex, distributed systems (Jennings, 2001) and have the ability to react to changes in their environment due to their reactive behaviour (Wooldridge, 1997). Emergency situations can therefore be treated adequately and both resources and personnel rescheduled. Ensuing resource conflicts can be managed by taking into account different priorities for personnel and resources.

2.2 Requirements analysis

One of the challenges in developing software systems is building the right system (Fowler and Scott, 2002). To accomplish this, a lot of effort needs to be put into domain analysis. Developing software systems using object-oriented approaches is supported by established methodologies such as “The Unified Software Development Process” (Jacobson, Booch and Rumbaugh, 1999). These methodologies guide the development of software systems by decomposing the process into several activities that range from requirements elicitation, analysis, system design, object design to implementation (Bruegge and Dutoit, 2000). Although there are established methodologies for the object-oriented development of software systems, advances are still necessary as the development faces both demanding and increasingly more complex systems. This is especially true when developing multi-agent systems. These present a need for adequate methodologies that support the development and deployment of multi-agent systems (Luck, McBurney, Shehory and Willmott, 2004).

3. PROBLEM STATEMENT

Multi-agent systems are widely used to address large-scale distributed combinatorial real world problems. One such problem is meeting scheduling (MS) in health care domain that is characterized essentially by two features defined from both its inherently distributed and dynamic nature i.e. the presence of patient’s preferences that turn it into a search for an optimal rather than a feasible solution. In this connection at least the following questions arise:

- ❖ When should the meeting take place?
- ❖ How to reach an appropriate hospital?
- ❖ What are the services available within hospital?
- ❖ How fast the doctor is available?
- ❖ Which Doctor is free to fix an appointment?
- ❖ How many patients will meet the doctor in a day, and who are they?

To solve it, the techniques of artificial intelligence are also used. An intelligent agent means that the agent has the knowledge about the interest and priorities of persons. Routine activities of physicians with regard to the meeting scheduling are practiced by agents in that way, that it filters and administrates information and answers questions. Supposing that every patient has got his own calendar, which is administrated by an agent, the reliability of his/her calendar will be very well. Also, a certain security of the private data is guaranteed.

“The problem is to develop a framework for distributed health care services using multi agent systems and to develop and implement an algorithm for the application of intelligent scheduling in health care domain using JAVA technology”.

4. System design & impementation of system

Proposed Approach, we are mainly concentrating on the data flow within the e-health care organization. At first data comes to the organization from the outside world using internet. That data is the patient information who wants to check-up by the doctor. Patient can get the service from the system using the Patient Agent (PA). When the doctor wants to check-up the patient he/she can get all the detail of the patient and give the medicine using Doctor Agent (DA) and all the internal activity is control by Controller Agent (CA) The agent is powerful, we are using the JADE agent building the user client and the server [4], when the agent is running the agent can autonomous get the environment information pass to the frame of user and server. For the JADE agent they have the follow advantages for we can use in this system [1]:

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Autonomous: The JADE agent can perform autonomously. Every agent have own executable thread. So that they can control own life-cycle at the time of performing some operation.

Peer-to-Peer: Each agent identify by own global name, so that they can join and leave the system at any time of the operation of the system by requesting the controller. They also identify other performing agent with the help of white-page and yellow-page services.

Distributed System: Every agent has separate thread for execution, so that they can run in different machines, different environment, and also can communication between them via internet.

Interaction Protocols: Some of the protocol options already exist in the JADE library, when need just using the function, so implementation is very easy.

Time requirement: Using the agent concept the whole system makes very fast, means it becomes less time consuming.

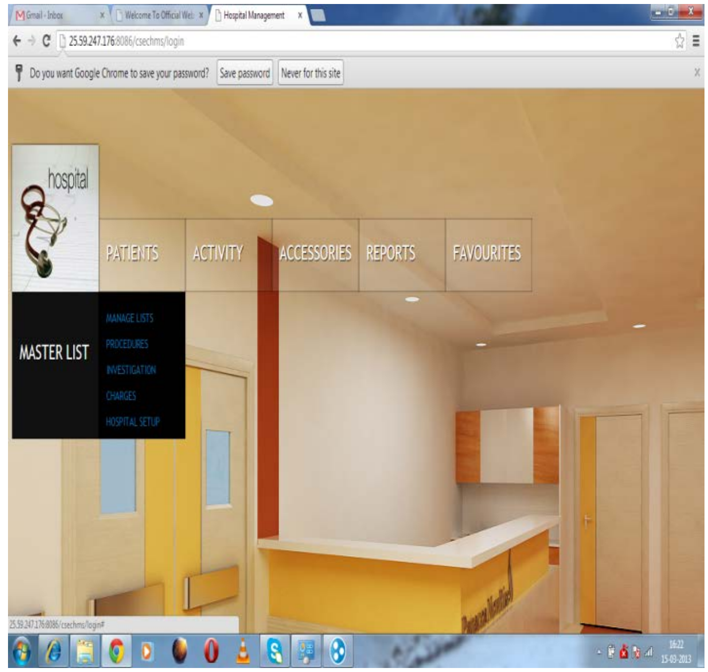

Fig2. Admin home screen

5. IMPLEMENTED AGENT WITH WEB TECHNOLOGY SNAP-SHOT

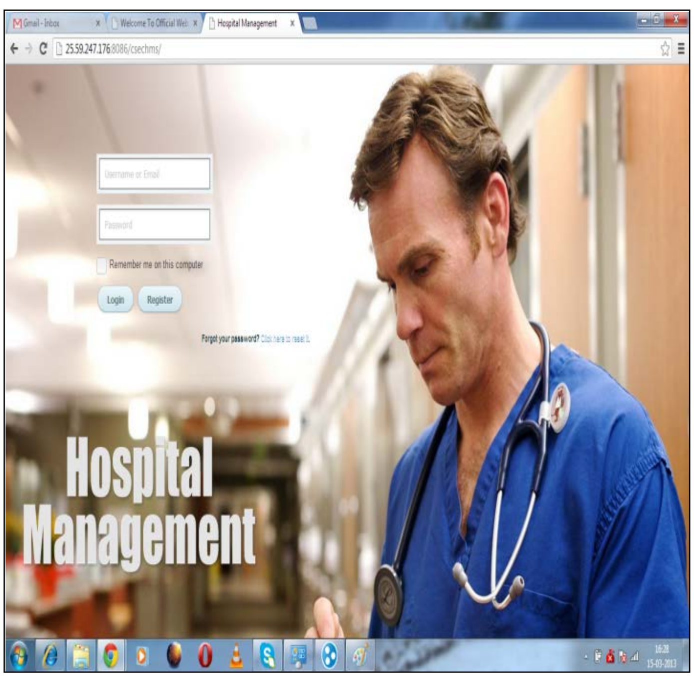

Fig1. Agent login hospital management

Fig3.Procedure view to administrator

6. CONCLUSION & FUTURE SCOPE

The objective of this research work was to design, implement a model which enhances internal functionalities of small e-health care organization. The data is stored in the database of the organization only patient and doctor can access the data. The model utilized multi agent concept using JADE technology, along with a database and file to store the data. All the operation is performed by Patient Agent (PA), Doctor Agent (DA) and Controller Agent (CA). The CA is the main responsible for controlling the whole operation. The operation is performed by agent that is way exestuation time very less. This model can be father implement using the intelligent agent concept. Where all the activity of the user is monitor and that data is used for increase the performance and decrease the exestuation time. AUML has illustrated how the enhanced richness of this notation can assist the expression and description of agent behaviours, interactions and architectures, especially when a multi-agent system designer needs to produce software specifications. We also recognise the limitations of AUML, particularly at the requirements gathering stage, where it is necessary to capture complicated, qualitative transactions that may not readily appear initially.

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