Abstract—In recent years, using of the intelligent agent has become important techniques especially in the domain of computers and informatics technology. The work is presented to concern with development of a multi-agent system (MAS) based on Bee-gent and used for health care purpose. The prototype of (MAS) was investigated and designed, and has been implemented based on mobile agent technology, visual C++ language and other related technologies. The implementation of (MAS) has been achieved through building the structure of (MAS), network which consists of server and multi-clients and building the database for each computer to store the updated information, in addition to registry file to save the IP address of server in each clients. Visual C++ language has been used for building the software part of the (MAS) inside the network and the Microsoft foundation classes (MFC library) are used to design the model frames of agents, and connect the database online within the system by using data access object (DAO library). The development of the MAS was achieved through building main database in server in addition to the individual database in each computer. Then, make the mechanism to search for one disease and update the specific client with medical information (symptoms and treatment) without human intervention and monitoring like specialist doctor. The results can be obtained as online update from server to clients with or without human monitoring, in addition to the update from clients to server.

Index Terms—mobile agent, database interface, physical network, visual c++ language, health care.

I. INTRODUCTION

INTELLIGENT Agent is a computational entity, which acts on behalf of user and other entities in an autonomous fashion, performs its actions with some level of proactively and/or reactivates, and possesses some key attributes such as learning, co-operation and mobility. The concept of agent came in mid 1970s [1]. During these few years, the strong trends in the internet technology and distributed systems have led to the point, where agent technology, in particular the mobile agent technology, is one of the "hot" topics in information systems research and development. Application domain, in which agent solutions are being applied to or investigated include workflow management, network management, information retrieval, personal digital assistants (PDA), education, health care, and so on [2]. The newcomers-mobile agents, which emerged in the mid 90s, can move from one computer to another [3]. During these few years mobile agent technology has been highlighted by many big research groups, like Agent Tcl [4], Aglet system [5], Agent cities [6], FIPA [7]. There are various reasons why mobile agents are highlighted more than static agent in recent years. These include their potential to address the problems of latency and bandwidth of client-server applications and the vulnerability of network disconnection [1]. When talking about intelligent agents, there are three dimensions or axes which must be used to measure the capabilities: agency, intelligence, mobility [8]. Agency deals with the degree of autonomy the software agent has in representing the user to other agent, application, and computer system. An agent represents the user, helps the user, guides the user. And in some cases, take unilateral actions on the user's behalf [8]. Intelligence refers to the agent to capture and apply application domain-specific knowledge and processing to solve problems [8]. An agent is mobile if it can move between systems in a network. Agents have the potential to assist in a wide range of activities in health care environments. They can maintain the autonomy of the collaborating participants, integrate disparate operating environments, and coordinate distributed data, such as patient records held in different departments within a hospital or in several hospitals, clinics and surgeries [9]. Therefore, health care at all levels-local, regional and international is a vast open environment characterized by shared and distributed decision making and management of care requiring the communication and Coordination of complex and diverse forms of information between a variety of clinical and other setting, as well as the coordination between groups of health care professionals with very different skills and roles. The aim of the agents or multi-agent system is to provide access to the basic health care service in a given city to meet the information needs of patients and health care providers [10]. Practitioners in health care environments, in particular require that the information in both timely and error-free, such as that recommendations or decisions offered by the software systems are secure and trustworthy [10].

II. INTELLIGENT SOFTWARE AGENT

Intelligent software agents has been defined as program that act on behalf of their human users in order to perform laborious information gathering tasks, such as locating and accessing information from various on-line information source,
resolving inconsistencies in the retrieved information, integrated information from several source, and adapting over time to their information need [11]. Software agent are computer programs, different from non agent programs in their ability to run autonomously, they must be self-contained, with data structure, method and interface necessary to interact with the operating environment (also known as the "agent subsystem") that is layered on top of the operating system. The structure of an agent program is clearly similar to that of the software object, and in practice agents are typically implemented as C++ or java classes (even if they are coded in higher level, rules-based language) [12]. While an agent is an encapsulated computer system that is situated in a certain environment and that is capable of flexible, autonomous action in that environment in order to meet its design objectives. A multi-agent system (MAS) can be defined as loosely coupled network of entities that work together to make decisions or solve problems that are beyond the individual's capabilities or knowledge of each entity. These entities or agents are autonomous and may be heterogeneous in nature [13].

III. HEALTH CARE BASED INTELLIGENT AGENT

Health care is a main part of the medical applications because this application describes a prototypical agent-based distributed medical care system. This system is designed to integrate the patient management process, which typically involves many individuals. For example, general practitioners may suspect that a patient has breast cancer, but this suspicion cannot be con-firmed or reject without the assistance of a hospital specialist. If the specialist confirms the disease, then a care program must be devised for treating the patient. Therefore, a multi-agent system (MAS) is presented to help health care practitioners in rural or remote area because, these agents provide an interaction mechanism with health care professional at remote site (area) to help the practitioners to diagnosis the disease and identify the treatment plan [14], one of the important and pure intelligent agent can be use to assistant the patient at home or health care practitioners at health care center is Bee-gent.

IV. BEE-GENT

The Bee-gent framework is a new type of pure agent development framework for the advanced network society and its communication framework is based on the multi-agent model. Bee-gent provides applications with autonomous network behavior by "agentifying" them (providing an agent interface), and supports agent-based inter-application communication, facilitating co-operation and problem-solving. The Bee-gent framework is comprised of two types of agents: agent wrappers and mediation agents.

Agent Wrappers are used to agentify existing applications. It is managing the states of the applications, which are wrapped around, and invoking the applications when necessary.

Mediation Agents support inter-application co-ordination by handling all communications between applications. It has the ability of moving from the site of an application to another where they interact with the agent wrappers.

Inter-application co-ordination is handled through the agent wrappers generating and receiving requests, which are transported around by the mediation agents as shown in Figure (1) [15].

V. SYSTEM DESIGN BASED ON BEE-GENT

The Bee-gent framework is used to implement the mobile agent in the system. The agent wrappers are used to wrap the client and server sides systems, and the mediation agents are used to perform the communication and exchange information with the wrapper agents as shown in Figure (2).

From figure (2), the main process scenarios within the system are:

A) On server side, the inference engine interacts with the group patient model which contains many partial individual patient models through the database interface, and checks whether something has been happened such as updated information within the database and the update has been sent to client periodically after encapsulating it with patient code and operation code. If something needs to be sent to clients, the inference engine notifies the wrapper agent with the information it is going to send. The wrapper agent creates a mediation agent carrying the information and related program and launches the mediation agent. If the mediation agent reaches the target client, it will communicate and exchange information with the client’s wrapper agent and the client’s inference agent communicates with its wrapper agent to get the data and processes them to update the client side patient model. The inference engine interact with many individual patient models, therefore, the process which doing it very difficult than the inference engine of clients.

B) On the client side, the procedure is similar to those described above, except the inference engine only interacts with the partial individual patient model.

After developing the architecture of (Bee-gent) system, the inference engine interact with main database and make special mechanism to update the client with information when client...
demand its. Figure (3) show the architecture of (Bee-gent) system after developing it.

VI. REQUIREMENTS

The requirements for both sides the server and the client are the same thing, the Figure (3) shows the Bee-gent (which has the mediation and wrapper agents), the inference engine, and database as explained in the following.

A. Requirements for mediation agents

The functionality of mediation agents, whenever they are created by server or client, is the same. The requirements for mediation agent are: 1) Communicating between the server and multi-client and transfer information between them. 2) Notifying its creator when the connection is not available or the update process fail.

B. Requirements for Wrapper Agents

Both server side and client side wrapper agents simply are the interfaces between mediation agents and inference engines. When wrapper agents receive visiting mediation agents, they act as translators, which pass the information back and forward between mediation agents and inference engines. When wrapper agents receive demands from inference engine to send mediation agents, wrapper agents create mediation agents and launch them.

C. Requirements for Inference engine

The inference engines are the core parts of the system. They initialize most processes and control the process flow. Requirements of client and server side inference engine are: 1) periodically checking the update information in individual patient model and determining whether the update of server side individual patient model has to take place. If yes, the data must be passed to wrapper agent for creating mediation agents. 2). Receiving information from its corresponding wrapper agents and updating the individual patient model.

D. Requirements for Database

Requirements of both server side and client side individual patient model are the same. They are based on the patient model database in the system; the mechanisms are added to indicate the state of update.

VII. IMPLEMENTATION RESULT OF INTELLIGENT

A. Architecture Overview of the System

The system is implemented with three tiers, client – server architecture as shown in figure (4):

- Client tier: contain individual patient model who interact with the group patient model in the server to exchange information between them or access remote information from main database.
- Middle tier: it resides on the server, where it handles the group patient model initialization and updates it. It is responsible for receiving client request, processing the data contained in request, and generating a client response based on the updated patient model.
- Database tier: the main database resides on the server side and store the information about diseases which it uses to update the client when request it from server.

Figure (4) is present the all system which wise to do, therefore, all three tier are performed really, after complete all programs and classes related to it like database access, wrapper agent (socket techniques), mediation agent (mobile agent). The communication between clients and server is mainly implemented with socket technique.
B. Connecting the Client with Server

This system (prototype) consists of two relatively separate subsystems (Agents): one run on local or client side (home or health care center) and the other runs on central or server side (the hospital). Therefore, the agent in client named as patient agent because it intended with patients healthy (used by patients or health care practitioners) and the agent in server named as doctor agent because its deal with specialist doctor as shown in figure (5 and 6).

C. Updating from server to client

When new information about one disease needs to be updated the patient in client from specialist doctor in server, the information written in its proper place in the screen and then press the update button as shown in figure(7).

After press the update button, the information is saved automatically in the database in specific field after doing the mechanism of update. The inference engine periodically check, if any event has happened as update, then, encapsulating the data with patient code and operation, after that, passed it to wrapper agent to create mediation agent carry the updated information and send it through the network to client after identifying the communication path between them. When the agent in client receive a mediation agent, passed it to inference engine to update the database through the mechanism of it and display the information in proper place in the screen as shown in figure (8).
D. Updating from Client to Server

The patient updates his information (parameters of disease) from the agent in client to the agent in server to see the healthy status from specialist doctor. Therefore, all process of updating are being done as same as the updating from server to client and illustrated it in flowchart in chapter three. The parameters of disease such as high blood pressure, low blood pressure and pulse rate are measure from specialist device was connected to human body and display accurate measurement as shown in figures (9) and (10).

E. Updating the Client without Human Monitoring

The information can be updating from server to client without human intervention and monitoring. Therefore, the information stored in main database and demand from server and updates the client after doing mechanism of search by inference engine. Figures (11 and 12) illustrate from where and how update the client with information about one disease.

F. Connecting other Clients to Server

When another agent (used by health care practitioner) in another client connect with the agent in server with different code and name of the patient agent from the other agent in other client was previously connected with server to exchange or access remote information from server. Figure (13) show another agent in client connected with the server and appear in the list of patients.
VIII. CONCLUSION

The following are the main points which are concluded from this work:

1. A development of intelligent assistant agent based on Bee-gent facilitates the interaction between clients and server to exchange and access remote information between them. It is utilized for health care purpose.
2. The (MAS) helps the patients to reduce their traveling to visit the hospital.
3. The problem of network traffic in the network is overcome by using sockets techniques.
4. Update the individual database in server and client online with information updated from server or clients.
5. Avoiding the problem of latency by updating the information online from server or clients by using the mechanism of local process.
6. The client is able to connect to any server in the network.

REFERENCES