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Multi Agent Electronic Cargo Terminal System

Saeed. K. Amirgholipour[1*], Aboosaleh. M. Sharifi[1], Mehdi Alirezanejad[2], Ali Hasiri[1] and Farshid MohammadZadeh[1]

[1]Department of Computer, Ramsar Branch, Islamic Azad University, Ramsar, Iran; s.kasmani@gmail.com; Aboosaleh.Sharifi@iauramsar.ac.ir, ali_hasiri@ymail.com, farshidmohammadzadeh66@yahoo.com
[2]Department of Computer, Firuzkooh Branch, Islamic Azad University, Firuzkooh, Iran; m_arn2004@yahoo.com, ali_hasiri@ymail.com, farshidmohammadzadeh66@yahoo.com

Abstract

In this paper, the usage of multi-agent systems for the management, control and optimize transportation system performance is shown. Artificial intelligence approaches in the development of intelligent agent-based systems is effective in solving complex problems in the transportation system. The successful transfer of research results to practical systems is crucial for intelligent agents and multi-agent systems. Our work reveals that the transportation system based on the intelligent agent can reduce costs, time and environmental pollution.

Keywords: AgentMom, AgentTool, Artificial intelligence, Multi Agent System, Transportation System

1. Introduction

In the communication era where internet plays a widespread role, employing electronic commerce solution besides internet tools in order to reduce process execution time is considered a necessity in countries. Erection of a strong web-based foundation prepares an appropriate frame for all e-commerce activities. Electronic cargo terminal system is believed to be one of the fundamental layers of regarded foundation. There are quite a lot of reasons for exploiting electronic goods transfer system. For instance using this system would decrease time, required for goods transfer as well as fuel consumption reduction and the time consumption cut to express the goods.

In the goods transfer current systems, used in country terminal; all relationships among terminals, goods owners and drivers are being executed by loads of paper works and in face to face meetings. Whereas by technology day to day enhancement on one hand and needs for quick material reception by companies and industries on the other hand, having a mechanical system which hastens the goods transfer activities is inevitable.

Regarding to goods transfer current system in country which wastes a lot of time and is considered to be breathtaking, we could use an appropriate electronic system that doesn't require execution cost to solve the concerned issues. The recommended solution which is proposed for such a challenge in merchandise transfer traditional system is to compose a multi-agent system for cargo transfer terminals[1,2].

In this paper, we strive to implement an electronic cargo shipment for those activities which don't require either in-person meetings or direct human interactions. This system is implemented by AgentTool and AgentMom Multiagent software. The suggested solution and following implemented system bring out a lot of additional value while thought to be a suitable method by which we are able to revolutionize traditional cargo transfer besides increasing their performance by using new technology. This system could make cargo shipment faster, and it reduce cost of shipment. Beside these, it could decrease environmental pollution.

2. Analysis

Analysis level in MASE entails three main sublevels as following[3]:

- Goal determination level
- Application determination level
- Roles revision level

*Author for correspondence

Within analysis stage, system properties definition is considered as inputs and existing roles are taken as outputs. Throughout diverse phases in analysis section, analyst knowledge will propel as various graphical documents are produced by such tools like AgentTool[4].

2.1 Goals Determination

The first section in MASE analytical approach is supposed to be system goal determination. System properties definition is assumed as inputs for this stage[5]. Hierarchical chart is regarded as output goal for the first phase of analysis. Goal determination level consists of two sublevels: goals recognition and goals categorization[6].

2.1.1 Goals Recognition

Goals awareness stage begins with constituting a general scenario. Later system general goals are determined based on regarded scenario. Below demonstrates a scenario for electronic cargo shipment system:

Scenario

Users can watch available goods list in cargo terminal besides available cargo drivers list via PCs and Laptops and by internet or even by the installed instrument on their vehicles or their offices, based on their accessibility type. Additionally if the specific conditions are met (e.g. true information, determined money payment or valuing the turn), users would be able to present or receive goods in order to ship to determined destination.

Drivers can search through the list of available merchandises while being introduced to cargo numbers and destinations, all by simply inserting decided cargo name and pressing a button. This capability can't be easily found in traditional cargo terminal. To put this theoretical ability in to the real system available goods keywords should be inserted into the database by the system responsible.

Those users whose cargo for transport, are capable of presenting their cargo properties to terminal in short time using their own PCs which are connected to worldwide internet and without being present at terminal offices while being suffocated by traditional paper works. Also in the same manner and without any need for paper works, they can be aware of the pervious merchandises status which they requested before.

Goals in electronic cargo terminal are:

- Merchandise exchange between goods owners and drivers
- The ability to view the list of available goods for both owners and drivers
- The ability for the owners to declare new merchandise to terminal
- The ability for driver to log into the system and input their characteristics
- The ability for drivers to view the list of all drivers
- The ability for drivers to view merchandises list
- The ability for drivers to obtain the authorized merchandise from the terminal

2.1.2 Goals Categorization

In this stage, the determined goals within pervious stage (i.e. goals recognition) are structured into a hierarchical tree frame Figure 1. In the electronic cargo shipment terminal if clause for goals hierarchical chart is compose as following. In this chart, merchandise declarations by the owner and authorization reception by driver are taken into consideration as main goals of this system. However, declaration facility; Drivers' login to list facility, goods view facility and showing drivers in order are concerned as partial goals in this system.

2.2 System Application Determination

Second level of analysis is the use of system application. The objective to this stage is to determine a set of applicable subjects based on initial information, available in system in order to sketch sequence diagrams. The system application determination is constituted with two sublevels: applicable subjects' creation and sequence diagram illustration.

2.2.1 Applicable Subjects' Creation

System diverse applications can be achieved either by system definition or communication with user if they are available. In this stage user's approach to system, being analyzed; is clarified. In MaSE, all applications

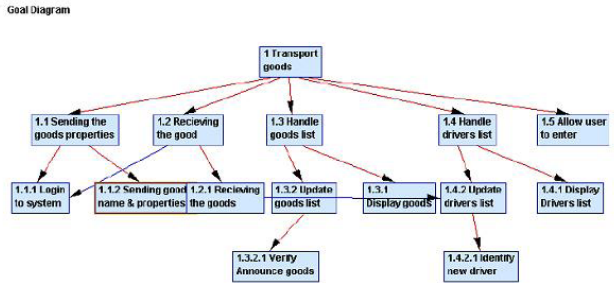

Figure 1. Goal hierarchy diagram of electronic cargo terminal system.

must be crystal clear in regard to communications participants' visions.

Inside the electronic cargo transport terminal the applications are elucidated separately based on merchandise owner and driver's views.

Owner's View

After logging into the system, Merchandise owner would get to terminal and is able to view available goods list as well as inserting name and properties of the goods. As long as the terminal confirms the merchandise, it will be listed in merchandise list.

Driver's View

After logging in the system, driver would go to the terminal and announce his name in drivers' list by entering his identity which includes his desired merchandise in terms of weight, transportation fee as well as inserting his status which describes whether he is in hurry or not. Then the driver should await his turn for choosing merchandise. All these priorities are employed to implement fuzzy driver agent well.

Furthermore each driver is able to view terminal merchandise list and when his turn comes by, choose merchandise as taking regarded priorities into consideration. Sometimes this driver needs to know which one of his province or city fellow is listed into terminal, thus for the sake of mentioned matter, a driver should be able to view the list of drivers. This is considered as why the regarded ability is given to drivers.

Terminal's View

As merchandise owner declares a goods for specific destination, terminal agent should evaluate merchandise status that if it is permissible. After permission check, if the goods are permissible, terminal agent should add a declaration in terminal merchandise list. Likewise, if a driver logs in the system, his quality including intelligent card possession, driving license possession and his health status must be verified for transporting goods. And if all meet the standards the driver would be qualified and inserted into terminal drivers' list.

The other duty for terminal agent is to announce the first person on drivers' list to choose his merchandise. To perform this, terminal agent is ought to send recurring messages to the first person on the list. These system applications are defined and implemented in AgentTool environment. You can find the applications list in Figure 2.

2.3 Sequence Diagram Development

By exploiting sequence diagram, events among different roles are drawn based on fabricated applications in pervious step[7]. In Figures 3 to 9 illustrations demonstrate sequence diagrams available in the system.

2.4 Roles Refining

Roles reassessment is the last analytic step in MaSE[8]. This section Target is to eventually determine roles in system in the way that intended roles are proved to be suitable for both design and implementation in multi-agent system locale[9]. In this regard, if the relations between two roles are numerous while they can be combined, those two

Figure 2. Applications list of electronic cargo terminal system.

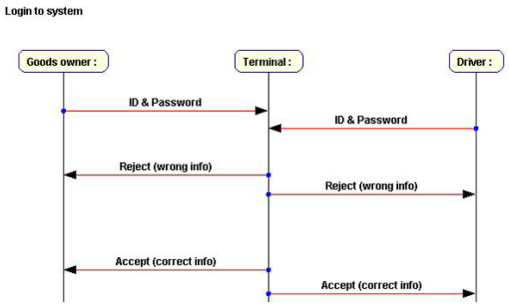

Figure 3. Sequence diagram of order of login to system in electronic cargo terminal system.

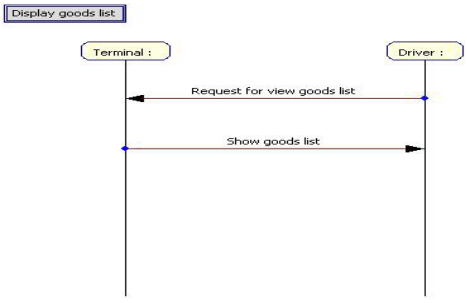

Figure 4. Sequence diagram of display goods list in electronic cargo terminal system.

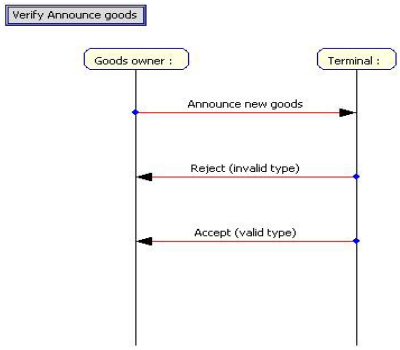

Figure 5. Sequence diagram of verify announce goods in electronic cargo terminal system.

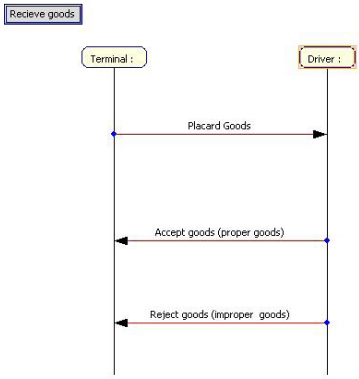

Figure 6. Sequence diagram of receive goods in electronic cargo terminal system.

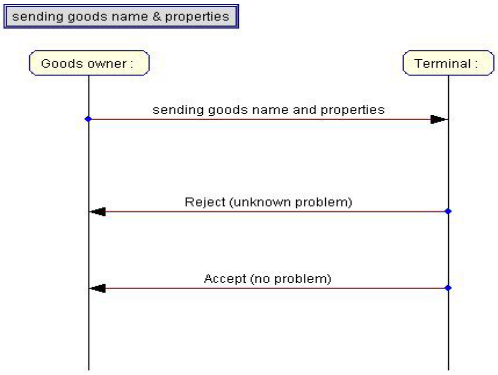

Figure 7. Sequence diagram of sending goods name & properties in electronic cargo terminal system.

roles will merge. In electronic cargo terminal system, relations among roles are not complicated. Moreover since all roles are considered as independent, they are impossible to merge.

Subsequent to this section is the determination of goals which each role is regarded as responsible. Each role

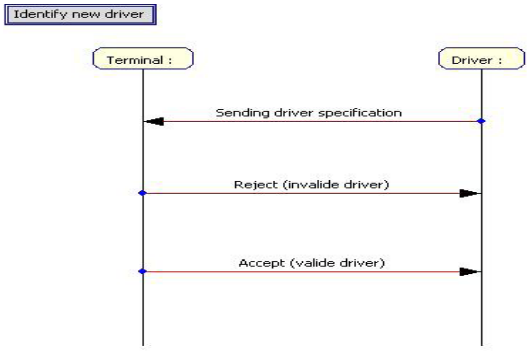

Figure 8. Sequence diagram of identify new driver in electronic cargo terminal system.

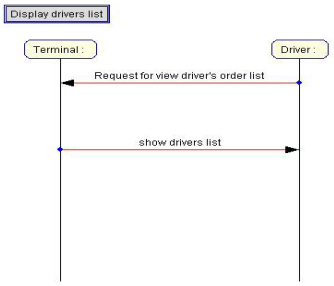

Figure 9. Sequence diagram of display drivers list in electronic cargo terminal system.

undertakes the responsibility to fulfill parts of mentioned goals that are demonstrated in hierarchical diagram.

2.4.1 Roles and Synchronic Duties Model

Following roles specification, each role will be determined in this stage. Each duty portrays a behavior which a role demonstrates in the way to reach its end. In electronic cargo terminal system, duties are as following:

Terminal Agent

Owner and driver's identity inspection, login permission issuance, owner's merchandise-which owner claims to declare it for freight inspection, saving merchandise properties in available cargo list in regard to cargo permission proviso, sought cargo inspection in order to deliver it to intended driver preceding to freight license issuance, freight license issuance and etc.

Merchandise Owner

Merchandise properties sending for terminal declaration, viewing available merchandise list, merchandise searching with specific name, owner's merchandise status pursuit.

Driver

Driver Putting his name in available drivers' waiting list for receiving goods, viewing available drivers' list, viewing terminal available transportable goods.

In Figure 10 illustration demonstrated diagram shows both roles in systems and each one's duty.

3. Design

Design level in MaSE is constituted with four main stages as following:

- Agent classes construction
- Conversation construction
- Agent classes combination
- System design

In the first stage of design level, thanks to analysis produced documents, new documents are made for system design. The implementation can be met easier Based on design level documents.

3.1 Agent Classes Construction

First stage in the design level is agent classes' construction. Agent classes are made inside this stage using created roles of analysis level. Relations among agents are determined identical to relations among roles in analysis level and just the one message which is needed for interaction initiation is shown in this stage. Agent class diagram is shown in Figure 11.

3.2 Conversation Construction

In this stage, conversations among agents build a model based on agent classes in pervious stage[10]. For each interaction, a machine draws a limited state for every participating agent in its relation. In these diagrams, state of each agent is clarified after related message sending and reception. Within electronic cargo transportation system, conversation diagrams are illustrated in Figures 12 to 25. In "cargo reception request conversation" driver agent, is the first one that starts.

3.3 Agent Classes' Conversation

In this stage internal architectures of agents are specified. Internal classes for every type of agents are elaborated based on predefined elements and their combination.

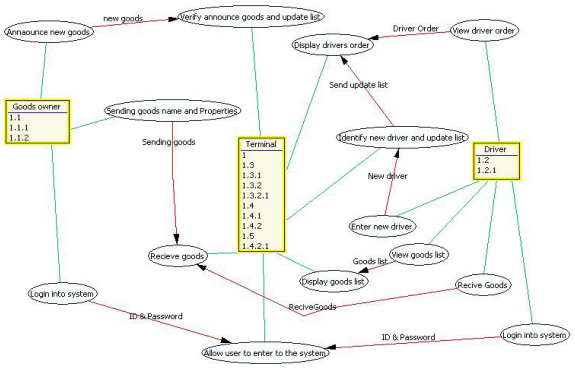

Figure 10. Model of roles and duty in electronic cargo terminal system.

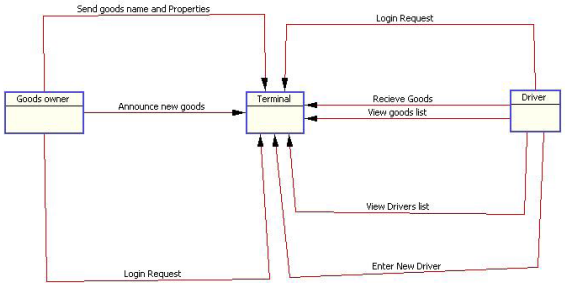

Figure 11. Agent class in electronic cargo terminal system.

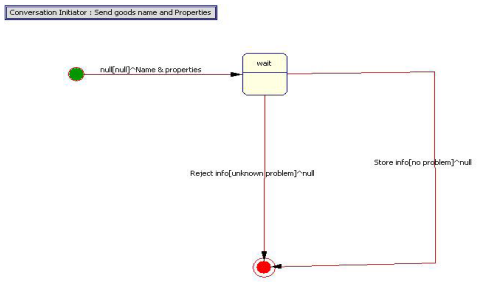

Figure 12. Conversation diagram of prompting new goods to terminal (Initiator: Goods owner).

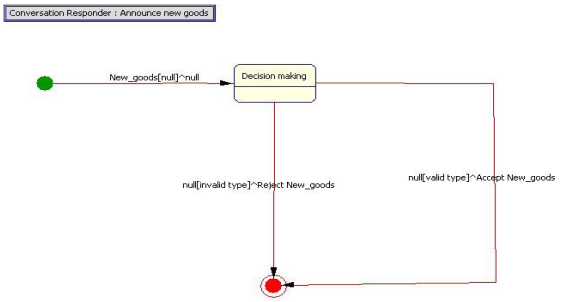

Figure 13. Conversation diagram of prompting new goods to terminal (Responder: Terminal).

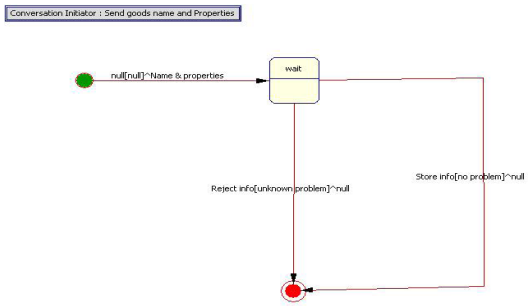

Figure 14. Conversation diagram of prompting goods name and properties to terminal (Initiator: Goods owner).

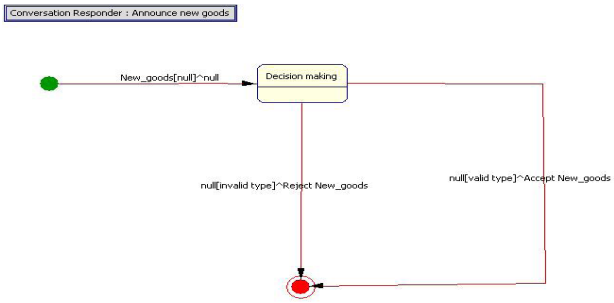

Figure 15. Conversation diagram of prompting goods name and properties (Responder: Terminal).

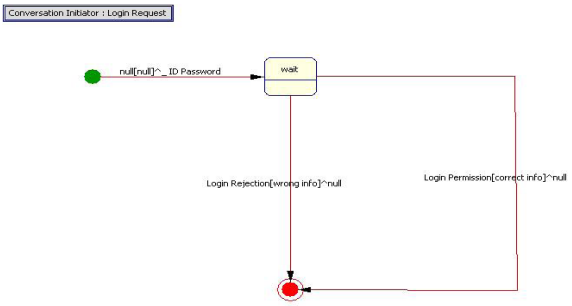

Figure 16. Conversation diagram of requesting for login to electronic cargo terminal system (Initiator: Goods owner-driver).

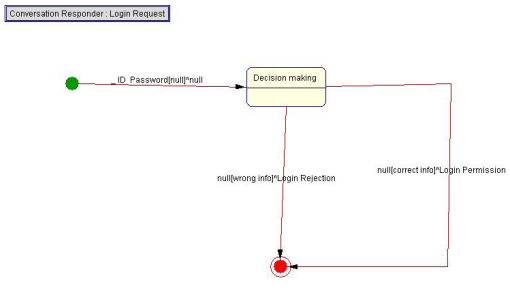

Figure 17. Conversation diagram of requesting for login to electronic cargo terminal system (Responder: Terminal).

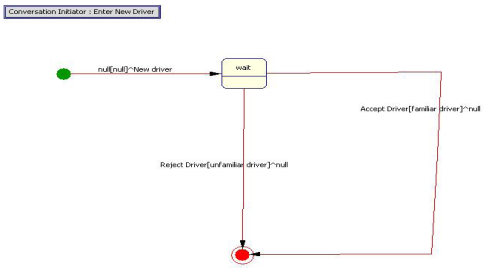

Figure 18. Conversation diagram of requesting of driver to register in list in terminal list (Initiator: Driver).

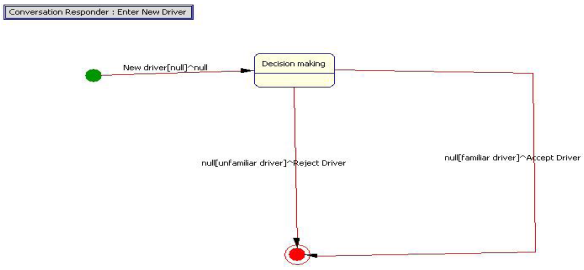

Figure 19. Conversation diagram of requesting of driver to register in list in terminal list (Responder: Terminal).

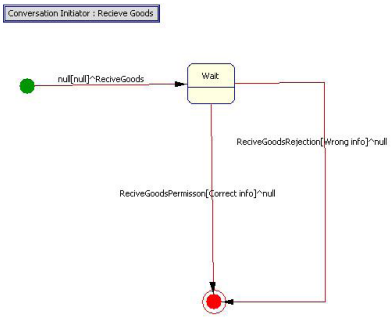

Figure 20. Conversation diagram of requesting of receive goods from terminal (Initiator: Driver).

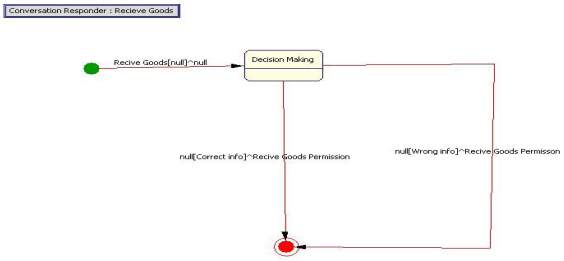

Figure 21. Conversation diagram of requesting of receive goods from terminal (Responder: Terminal).

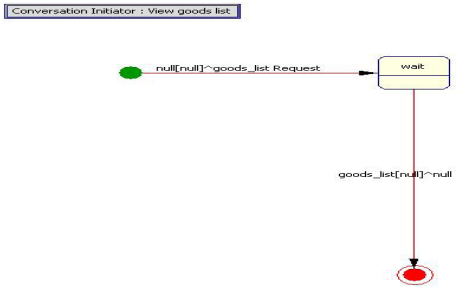

Figure 22. Conversation diagram of requesting of view goods list from terminal (Initiator: Goods owner-driver).

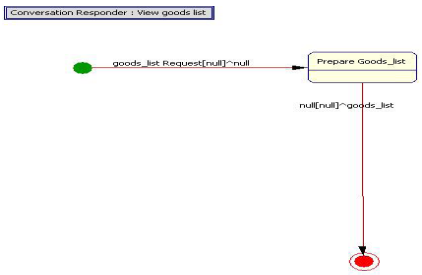

Figure 23. Conversation diagram of requesting of view goods list from terminal (Responder: Terminal).

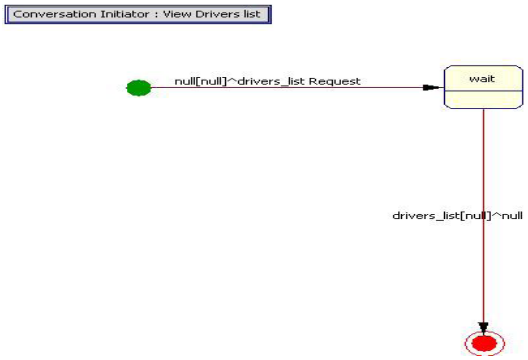

Figure 24. Conversation diagram of requesting of view Driver list from terminal (Initiator: Driver).

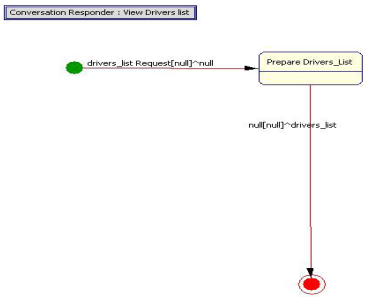

Figure 25. Conversation diagram of requesting of view Driver list from terminal (Responder: Terminal).

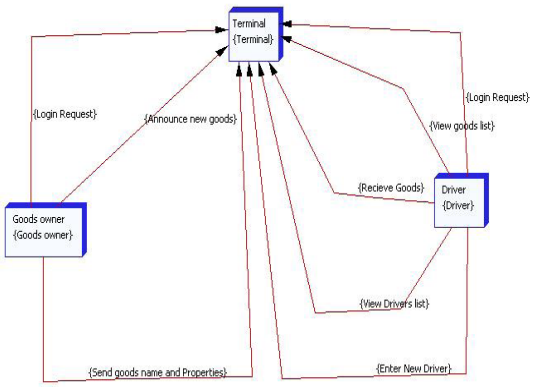

Figure 26. Structural style diagram for electronic cargo transportation system.

In electronic cargo transportation system and in respect to system definition, "reactionist architecture" type seems suitable for each terminal, owner and driver agent. In reactionist architecture, agent responds to the environment messages by specific rules. In regard to the specific strategies for terminal agent, merchandise owner's agent and driver's agent are considered to be predefined and clarified rules in the system, reaction list architecture seems appropriate.

3.4 System Design

Last level is system design in MaSE. In this level by taking agent classes into account, samples of agents, available in the system will be shown in application system[11]. As system can be used distributively, numbers, types and location for every sample are created in this section. Figure 26 demonstrates related structural style diagram for electronic cargo transportation system. In regarded system there should be at least one agent from available agents.

4. System Implementation

In this section all the focus is on system implementation. Implementation is a level in which all abstraction in both analysis and design level is realized. One of the positive characteristics of software engineering methodology is that through conducting system analysis and design, some documents are provided by which implementation would be less demanding and elevation of system quality would be met, too.

There are various frameworks and tools for putting regarded matter into action by which we may overcome

some complications in agent-based systems. For instance we can pinpoint one of the frame works called AgentMom[11]. To instigate system in MaSE this level is not predicted but by AgentMom we are able to skip design and implementation level. AgentMom is a template for distributive agent-based system construction which is implemented in java environment. The regarded template provides us with main blocks of agent construction, conversation among them and sent and received messages.

AgentMom ascendancy is that if MaSE methodology is used alongside with AgentTool implement in system analysis and design as well as the ability of code generation in AgentTool itself, we are capable of sketching intended system general structure. It is taken for granted that system implementation details should be added to initial code, created by AgentTool.

4.1 AgentMom Acquaintance

AgentMom is a framework for constructing distributed multi-agent systems which is implemented in Java, providing us with essential initial blocks for agent construction, conversation among them and sent and received messages.

AgentMom work review is prepared in Figure 27. Agent is able to communicate with other agents by beginning from a message handler – which controls and listens to a local port in order to receive a message. All communications among agents are executed through conversation which is constituted with a set of reliable messages, used by agents in order to communicate information with one another.

When an agent wants to establish its communication with another one, it runs one of the conversations as a java thread. Conversation establishes a socket connection with another agent's message handler and sends the first message of conversation. Message handler deliver received message to agent receive Message in order to examine its authentication as initial message no.1. If the conversation is declared as authentic agent begins its side conversation in a java thread template.

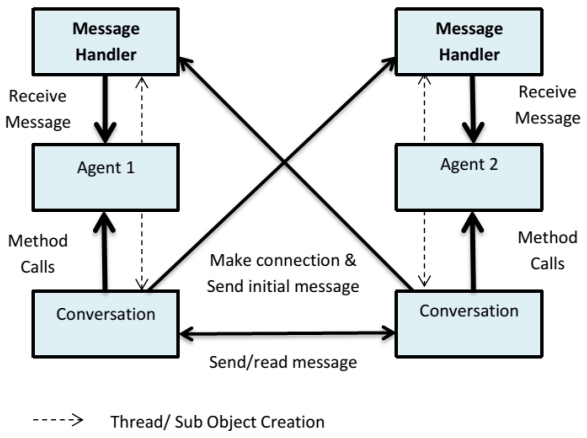

Figure 27. AgentMom.

Form this point on all communications are controlled by two threads. Conversations exchange messages by send Message and receive Message methods. Conversation blocks in both agents execute message exchange. Moreover, methods are called for conversation block communication with its own agent.

5. System Advantages

Using the proposed system for e-transport goods has a lot of advantages. These advantages are described below.

5.1 Increase the Speed

Electronic systems can increase the speed of goods transporting. To understand the issue better, consider this scenario: The owner of the goods to declare that a product has to ship to certain destinations. The driver should go to Terminal and according to his interest to choose goods for shipment to its destination in the Classical system of transporting goods. The time is spent around 5–10 hours for this job. (Maybe the driver when the goods are declared for loading is in the same range, and the terminal is located at another point.) If the proposed system to be used for notifying the driver at the same time of declaring of the goods, this extra time spent for the move is not required. (The driver does not need to move from the other side of town to the place of terminal.) This system makes a declaration after the goods in less time, weekly, and thus the shorter the time the goods arrive. This system makes a goods transport in shorter time.

5.2 Reduce Fuel Consumption, Traffic and Environmental Pollution

On the other hand, this system will reduce fuel consumption and environmental pollution. If the large number of movements that are similar to the scenario above is considered. It can be found simply by reducing the unnecessary movement of traffic and reduced fuel consumption and subsequently, the amount of pollution reduced.

5.3 Reduce Costs

This electronic system can be reduced cost. If the driver does not have the extra distance to get out of the goods, the depreciation costs associated with car parts and tires reduced.

5.4 Lack of Time and Space Constraints

Since the electronic system is available in anytime and anywhere, this system also is not limited to the spatial and temporal expression profile. The result is high system availability.

5.5 Transparency of the Tax System

According to the proposed intelligent systems, the employer's illegal demands have no effect on the system operation, because all activity registered in the system and can be pursued. It can easily calculate the cost of revenues such as taxes, insurance and other fees. The financial performance of the system is transparent and there is not a possibility of financial irregularities and to request additional funds from the driver and owner of the goods there.

6. Conclusion

The use of Multi-Agent Systems for the transportation of goods is proposed. There are drivers, the terminal and the merchandise owner's agent in an electronic cargo terminal system. At first, the goal of the system is specified according to these agents. The sequence diagrams of communications between the agents in system are described. After that, different roles in the system are more accurate and more detailed review and refined. Next, the agent classes are constructed for each agent in the system and then a graph of how the dialogues between these classes were designed. Finally, these classes have been combined and a multi-agent system is designed for electronic cargo transportation system. The agent mom and agent tools are used for design of this system. These tools have capabilities of to show visual communication between the agent and of generate java code. The proposed system for reducing fuel consumption, reduced air pollution, increased speed of transporting goods can be used besides being more transparent tax transportation system. As a result, this system finds very effective in improving processes and actions of the classical transport system.

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