Contract Net Protocol Based-on Multiagent System for Desirable Jeep Car

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Abstract

This paper use Contract Net Protocol based-on multiagent system for purchasing car system. Normally, buyer look for desire car with search engine or buyer must go every Industrial Zone or Company (produce jeep car) for desire jeep car. Perhaps you are lucky and find a map showing how to get to Industrial Zone Or Company. This system using Contract Net Protocol could solve these problems. Contract Net allows tasks to be distributed among a group of agents. One of the most promising uses for Contract Net is to create an electronic marketplace for buying and selling goods. In this agency system, the buyer/customer certainly goes to this system and he/she can view car design and car data. And then, he/she can choose desire jeep car by selecting car's items. This system automatically choosing suitable jeep car for user. Not to navigate to the every websites of Myanmar or not to go to the every Industrial Zone or Company because this system is special for customers who will buy Jeep car.

1. Introduction

Agent is a computer system that is capable of independent action on behalf of its user or owner. Agent in a multi-agent system may have been designed and implemented by different individuals, with different goals. Different types of agents are software agent, mobile agent, reactive agent, cognitive agent, hybrid agent, interface agent and middle agent. Among them, this system uses software agent which is defined as being a software program that can perform specific task for a user and possesses a degree of intelligence that permits it to perform parts of its tasks automatically and to interact with its environment in a useful manner.

Multi-agent systems are system composed of multiple interacting computing elements, known as agents. Multi-agent is the part of computer systems and communication between these systems using different type of multi-agent coordination techniques. There are four categories of techniques – organizational structuring, subcontracting, negotiation and multi-agent planning. Negotiation technique is used in this system. This techniques is based-on contract net approach(smith,1980) – is high level coordination strategy that also provides a way of distributing tasks, and a means for self-organizing agents in a group. This system is intended to apply especially by the buyer, for example, who will buy jeep cars which produce in Industrial Zone in Myanmar. In this system, agent processes automatically to give user requirements. In this system, there are two types of agent – manager agent and candidate agent working together. The manager agent accepts the input from the user and then announces the task to all candidate agents. Each candidate agent receives the announcement of specific Jeep car's items which is going to be bought by the buyer from the manager agent and then decides if it is eligible for the task. If it is eligible, then details of the task are stored, and the candidate agent will bid for the task. And then, manager agent receives bids from would be contractors. The manager then awards the task to a single bidder.

2. Related work

Chrysanthos Dellarocas and Mark Klein [1] proposed a research methodology for designing and evaluating electronic social institutions. This paper also describes how the methodology is currently being applied in order to design and evaluate robust open architectures for agent-mediated marketplaces based on the contract net protocol. Oueladj D., Cowling P.I. and Petrovic S [3] presented a negotiation protocol proposed for inter-agent cooperation in a multi-agent system which is developed for optimization and dynamic integrated scheduling of steel production. The negotiation protocol is a two-level bidding mechanism based on the contract net protocol. Reid G.. Smith [4] described the implementation of heuristic search algorithms in a distributed problem solver whose processors interact according to the contract net protocol. Task distribution is viewed as a local mutual selection process based on a two ways transfer of information between processors with tasks to be executed and processors with knowledge-sources capable of executing those tasks. Dulce J. Magana Lozano, Arturo Lopez Pineda and Ramon F. Brena Pineiro [2] described a multiagent-based solution to the problem of managing airplanes in such airlines. An implementation of the Contract Net protocol for establishing the communication among airports and airplanes is presented, including a

prototype using the NetLogo platform.

3. Background Theories

The contract net protocol is high-level protocol that describes how communication and control will take place between two problem solvers (otherwise referred to as Knowledge sources, KSs, agents or experts). It is referred to as "high-level" simply because the focus is on what the nodes should say to each other not how to say it. Contract Net specifies the interaction between agents for fully automated competitive negotiation through the use of contracts. In essence, Contract Net allows tasks to be distributed among a group of agents.

There are many advantages by using contract net protocol. One primary advantage to the contract net is its reliability. The distributed structure and lack of command translate to an ability to recover if an individual agent becomes suspended or disabled for any reason. In the situation where an agent that has been contracted to execute a task becomes disabled, the manager agent can award the contract to another agent when no report or result is received from the contractor. The situation may be a bit more complex if an agent becomes disabled while in the role of a manager, since contractor agents may have already committed significant resources prior to realizing that the manager will no longer be able to compensate their efforts.

3.1 Software Agent

Software agent is a software component that has characteristics, some of which concern agent's internal capabilities and some relate to the agent's external behavior. Internally, agent has some decision making capabilities. Externally, the agent reacts to situations, takes initiative influencing its surroundings and may even be social. The following features are characterized of agents:

- Intelligence refers to agent's ability to make reasonable decisions based on its observations and internal knowledge.
- Autonomy means that an agent can act on some problem based on its (often imperfect) observations without a constant guidance from user.
- Reactivity means that the agent reacts to events happening in the environment. Good reactive capabilities are essential when the agent operates in an environment it is not familiar with.
- Proactivity means that the agent does not just wait for events to happen. It also takes initiatives in order to advance its goals.
- Sociality refers to the human-like way the agent interacts with other agents

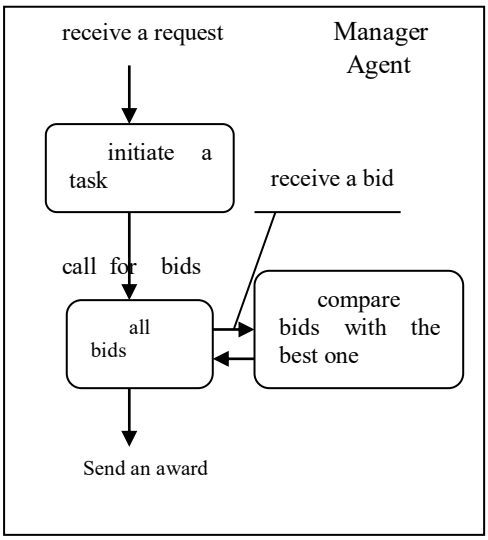
As an agent is a conceptual entity (not an implementation technique), using agents does not automatically add any intelligence to an application or system. Instead, the agent-concept provides a flexible and scalable platform for theories of distributed artificial intelligence to be implemented.

3.2 Collaborative Architecture

Collaborative attitudes are incorporated in such agent systems to facilitate interaction, communication, task decomposition, distribution, cooperation, and negotiation. Collaborative agents systems emphasize the concept of "agency". Agency relates to the characteristics and behaviors of individual agents operating in a multi-agent system.

Agent using the Contract Net (Smith,1980) as the basic for their inter-agent negotiation protocol has a simpler collaborative architecture, where as agents using extended or modified version of the Contract Net protocol have more complex internal architectures.

Agents using the same version of the Contract Net as their negotiation protocol may have different internal architecture composed of different numbers of the module (components). However they will have similar decision making mechanisms, considered from the agent collaborative point of view. The figure (1) shows the decision making mechanisms in a Manager agent and a Bidder agent.



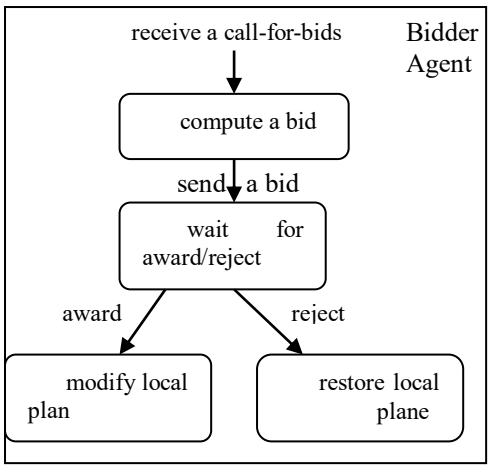


Figure. 1. Manager Agent and Bidder Agent Using the Contract Net Protocol

3.3 Contract Based Negotiation

Each agent (manager) having some work to contract broadcasts an offer and waits for other agents (contractors) to send bids. After some delay, the best offers are retained and contracts are allocated to one or more contractors who process their tasks. The contract net protocol provides for coordination in task allocation, with dynamic allocation and natural load balancing. The approach is quite sample and can be efficient.

However, when the number of node is large, the number of messages on the network increases, which can lead to a situation where agents spend more time processing messages than doing the actual work, or worse, the system stops through being flooded by messages. Thus, various improvements to the basic contract net approach have been proposed, such as:

- Sending offers to a limited number of nodes, instead of broadcasting them;
- Anticipating offers, that is, contractors send bids in an advance;
- Varying the time when commitment is decided;
- Allowing de-commitment (breaking commitments);
- Allowing several agents to answer as a group;
- Introducing priorities for solving tasks.

3.4Contract Net Protocol

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The Contract Net protocol is a high-level protocol for achieving efficient cooperation through task sharing in network of communication problem solvers. The basic metaphor used in the CNET is, as the name of protocol suggests, contracting – Smith took his inspiration from the way of that companies organize the process of putting contracts out to tender in figure (2).

Node [manager] that generates a task advertises existence of that task to other nodes in the net with a task announcement, then as the manager of that task for its duration. In the absence of any information about the specific capabilities of the other nodes in the net, the manager is forced to issue a general broadcast to all other nodes. If, however, the manager possesses some knowledge about which of the other nodes in the net are likely candidates, then it can issue a limited broadcast to just those candidates. Finally, if the manager knows exactly which of the other nodes in the net is appropriate, then it can issues a point-to-point announcements. As work on the problem progresses, many such task announcements will be made by various managers.

Nodes in the net listen to the task announcements and evaluate them with respect to their own specialized hardware and software resources. When a task to which a node is suited is found, it submits a bid. A bid indicates the capabilities of the bidder that are relevant to the execution of the announced task. A manager may receive several such bids in response to a single task announcement; based on the information in the bids, it selects the most appropriate nodes to execute the task. The selection is communicated to the successful bidders through an award messages. These selected nodes assume responsibilities for execution of the task, and each is called a contractor for that task. After the task has been completed, the contractor sends a report to the manager.

In addition to describing the various messages that agents may send, Smith describes the procedures to be carried out on receipt of a messages. Briefly, these procedures are as follows.

(1)Task announcement processing

On receive of a task announcement: an agent decides if it is eligible for the task. It does this by looking at the eligibility specification contained in the announcement. If it is eligible, then details of the task are stored, and the agent will subsequently bid for the task.

(2) Bid processing

Detail of bids from would be contractors are stored by (would be) manager until some dead line is reached. The manager awards the task to a single bidder.

(3) Award processing

Agents that bid for the task, but fail to be awarded it, simply delete detail of the task. The successful bidder must attempt to expedite the task (which may mean generating new sub-tasks).

(4)Request and inform processing

These messages are the simplest to handle. A request simply causes an inform message to be sent to the requester, containing the required information, but only if that information is immediately available. An inform message causes its content to be added to the recipient's database. It is assumed that at the conclusion of a task, a contractor will send an information message to the manager, detailing the results of the expedited task.

The Contract Net has become the most implemented and bet-studied framework for distributed problem solving.

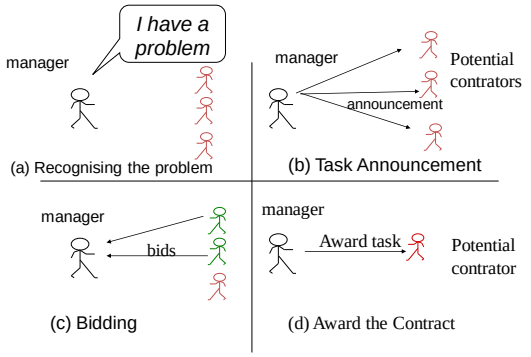

Figure. 2. Contract Net Protocol

3.5 Advantages of Contract Net Protocol

There are many advantages of contract net protocol.

- Dynamic task allocation via self-bidding, which lead to better agreements.
- Natural load-balancing.
- The most implemented and best-studied framework for distributed problem solving,
- Proving reliable mechanisms for distributed control and failure recovery.
- Avoiding bottleneck since tasks are not always sent to the same processing nodes.

4. SYSTEM ARCHITECTURE

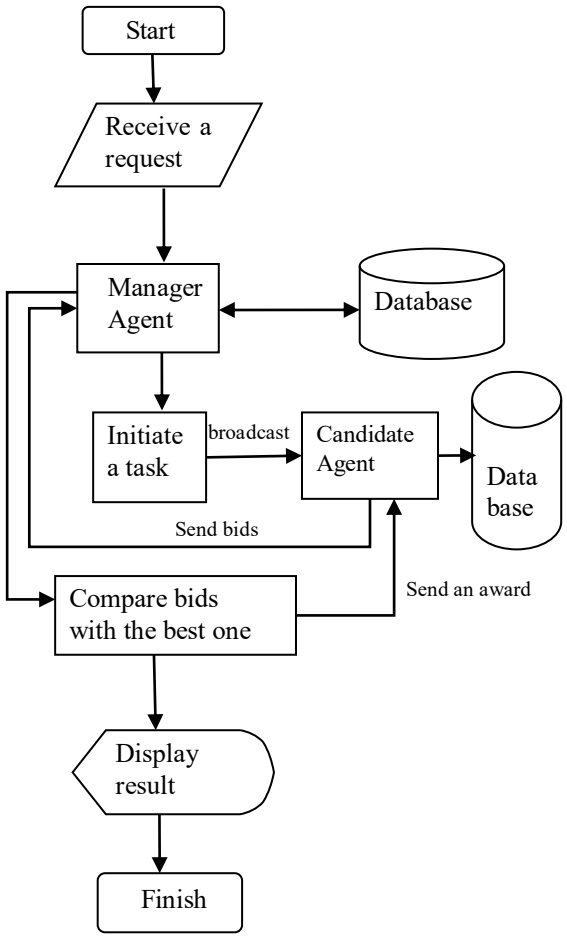

Figure. 3. System Flow Diagram

The fundamental architecture of system flow diagram is shown in figure (3). The system consists of a Jeep car information database and two major subsystems: one manager agent and three candidate agents. The system's input is Jeep car's items: Manufacture Zone, Brand, Engine, Colour and Price. User inputs to the manager agent. And then, manager agent that generates a task announcements and evaluate them with their own database. When a task to which a candidate agent is fond, it submits a bid to the manager agent. Manager agent receives several such bids in response to a single task announcement and selects the most appropriate candidate agent to execute the task. Then manager agent send award message to the selected agent. Manager agent compares results of the all candidate agents and chooses the best one by the following description.

Example of task announcement for manager agent

To :* <"*" indicates a broadcast to all candidate agents
From : Manager Agent
Task : Buy Car
JeepCarQualities:
Manufactured Zone: MDY
Engine : 2C
Brand : SKY
Colour : Gray
Price ($) : 5000

Example of Bid Processing for Candidate agent1

To : Manager Agent
From : Candidate Agent1
JeepCarQualities: Manufactured Zone: MDY
Engine : 2C
Brand : SKY
Colour : Gray
Price($) : 5000

Example of Bid Processing for Candidate agent2

To : Manager Agent
From : Candidate Agent2
JeepCarQualities : Manufactured Zone: MDY
Engine : 2C
Brand : SKY
Colour : Gray
Price($) : 5500

Example of Bid Processing for Candidate agent3

To : Manager Agent
From : Candidate Agent3
JeepCarQualities: Manufactured Zone: MDY
Engine : 2C
Brand : SKY
Colour : Black
Price ($) : 5000

With the above description, Manager agent compares bid processing from all candidate agents with priorities of car price. Candidate agent1 and candidate agent2's qualities of jeep are similar to the user's request but price are not the same. In candidate agent3's qualities of jeep, colour is different from user request. That manager agent selects candidate agent1 by comparing car price because agent's price is less than agent2 according to user's requested car price.

4.1 Functions of the Agents

In purchasing car system, it is divided into four agents which are manager agent, candidate agent1, and candidate agent2 and candidate agent3. Figure.4 shows their structural relationships.

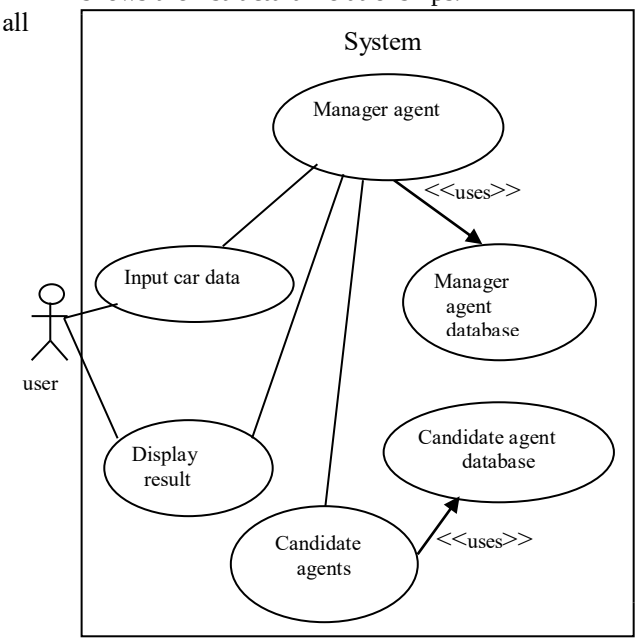

Figure. 4. The relationship of the agents system

4.1.1 Manager Agent

Manager agent has the responsibility to receive user's input and to send result information to the user. First, manager agent receive input from the user and then will send this input to the candidate agents1, 2 and 3 to check user's input and to find the relevant information according to this input. Each candidate agent will work each of their tasks. All candidate agents send the result to the manager agent. And then manager agent accepts result from all candidate agents and compare results with the best one. The manager agent sends award or reject to all candidate agents and manager agent returns it to the user.

4.1.2 Candidate Agent

In this paper, all candidate agents work for selling Jeep car which is produced in Myanmar Industrial Zone. All agents use own database. This database includes the name of industrial zone, brand, car engine, colour and price. First, all agents receive user input from manager agent. Then they compare user input and display results to manager agent by using their own database. If their results are suitable for user, manager agent sends accept message for selected agent or reject message to other agent.

4.2 Proposed Algorithm

The following algorithms are to use for manager agent and candidate agents.

Let 'Info' be the input(Jeep car's data: Manufacture Zone, Brand, Engine , Colour and Price) from the user.

(1)User

```
Procedure user
Begin

    (1) sendInfo( ) // user sends Info to Manager
        agent
    (2) receiveResult( ) // user receives result
        from Manager agent

End
```

(2) Manager agent (MA)

```
Procedure MA (string  Info)
Begin

 (1)  receiveInfo( ) // MA receives Info from user
 (2)  sendInfo( ) //MA sends or announces Info to
      CA1,CA2 and CA3.
 (3)  receiveBids( ) // MA receives bids from
      CA1 ,CA2 and CA3.
 (4)  choiceSuitableBid( ) // compare bids with
      the best one
 (5)  sendResult( ) // MA agent sends result to
      user

 End
```

(3) Candidate Agent (CA1)

```
    Procedures CA1( string Info)
    Begin

    (1)  receiveInfo( ) // CA1 receives Info from
         MA
    (2)  CHECK = doCheck(Info)
    (2.1) if CHECK is valid then
    (2.1.1) doProcess( )
    (2.1.2) sendrsult( )
          else
              waitNextSendInfo( )
  End
```

(4) Candidate Agent (CA2)

```
    Procedure CA2( string Info)
Begin

(1)    receiveInfo( ) // BA2 receives Info from
       MA
(2)    CHECK = doCheck(Info)
(2.1) if CHECK is valid then
(2.1.1) doProcess( )
(2.1.2) sendresult( )
      else
         waitNextSendInfo( )
End
```

(5) Candidate Agent (CA3)

```
 Procedure CA3 (string Info)
 Begin

(1)  receiveInfo( ) // CA3 receives Info from MA
(2)  CHECK = doCheck(Info)
(2.1) if CHECK is valid then
(2.1.1) doProcess( )
(2.1.2) sendresult( )
      else
          waitNextSendInfo( )

End
```

5. Conclusions

This paper has presented the framework of Contract Net Protocol based purchasing desirable car system. The Contract Net protocol has been hugely influential in the multiagent systems literature. Multiagent system is the part of computer systems and communication between these system using different type of multiagent coordination techniques. Negotiation techniques is based-on contract net which is high level coordination strategy that also provides a way of distributing tasks and a means for self-organizing agents in a group. The contract net implements for distributing task dynamically to node in the network. When a node has to solve a problem for which it does not have expertise, it broadcasts a task-announcement messages which describes the task to be solved. The proposed system is sample to use and can be helpful in real world purchasing desirable car system.

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