Tracking Document of Disposition Letter by Using Mobile Agents on Distributed Information System

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Abstract

Nowadays, the information system on the document processing has not much used the artificial intelligence technology. The existing system is still much using the hands of human as its operator or as its user. This research proposes an anonymous model by using mobile agent system approach to support the searching process of disposision letter in the information system. The process of the agent communication uses Agent Comnunication Language (ACL) message and ontology. This system uses relational data base. This research is aimed at creating a model of file tracking by using mobile agent system technology which is applicable in the institution's information system. The application of the mobile agent system which is autonomous is used to search the document files in the institution's distributed information system and this has been simulated.

Keywords*: tracking, letter of disposition, mobile agent, relational database, ontology.*

1. Introduction

Nowadays, it is still rare to find the application of agent based system implemented on the Information System of document processing in companies. Most of the built system only uses the conventional technology not the technology of autonomous system. Many still count their operation on using the human resource as the operator or the user.

For example, the distriduted application of a computer network in a company saves various documents spread in many locations. Each department or unit processes them individually very well. There are many computerized solutions to solve this problem, however, the most frequently used solution which is applied in the computerization still needs the help from human as its operator, such as in the processing of database document file searching, the accuracy and effectivity of certain document will give a good or less good output depending on what was inputed by the operator into the application system. Of course it needs the operator's skill and intelligence to get the best output.

It becomes a challenge if the existing system can be developed into a new model which is autonomous in which the computer system is built and designed to be able to do its works individually without needing much to think the result from the operator. Therefore his involvement can be decreased. This kind of system model adopts the advance of *artificial intelligence.*

This research proposes a type of an autonomous system modeling by using the technology of artificial intelligence using mobile agent system approach to support the searching process of disposition letter in an Information System.

This research is aimed at creating a file searching model based on letter of disposition by using technology of mobile agent system which can be applied to in the institutions information system.

The problem proposed in this research is how the application of mobile multi agent system is used to create an autonomous system in searching files in the institution's information system.

2. Related Works

2.1 Mobile Agent

Agent is an active entity which can migrate from one place to another one to meet the other agents and to access the services available in other places. The levels of agent migration are Transport of code + data: *Messaging Passing/Code on demand*, Migration of Code + Data:

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Weak Migration, Migration of Code + Data + State: *Strong migration* [1].

The models of designing mobile agent used to be implemented are itenerary, star-shaped, and branching [2].

2.2 Migration of Agent

Hyeok Chan Kwon, et al proposed an algorithm that manages the best agent migration plan related to minimalizing the execution time on a network. There are three paradigms on the working evaluation model: RPC (Remote procedure Call), mobile agent, and Locker Format [3].

Guillaume Autran and Xining Li stated that they can handle the agent migration and the communication between agent by mobilizing the simple protocol of agent migration focusing on the protocol stack specification and its implementation [4].

Donghong Qin and Zhi Li proposes an approach to catch and rebuild the agent runtime focusing on the techniques of mobile agent's strong migration [5].

Peter braun, et al identifies several reasons of the mobile agent's bad performance which most of them related with the Java programming language. Therefore, a solution is proposed to overcome those problems and the experiment result presents its effectivity [6].

According to Migas n, Buchanan WJ and McArtney K, the time needed to collect the routing information can be decreased significantly by using mobile agent approach compared to using static agent approach [7].

Masayuki HIGASHINO, et al proposes a method to decrease a number of agent migration because it causes the increasing of the data traffic. Cached code and status used come back when the agent comes back again. Therefore, this method is able to decrease the data traffic caused by the mobile agent migration in the invorenment level of the agent runtime [8].

2.3 Agent Communiation

Joan Ametller, et al, implemented agent migration between platform based on FIPA ACL in the electronic trade so that it has its own standard and supports its interoperability. The platform being used has been integrated with JADE [9].

Joan Ametller-Esquerra et al, carried out an approach based on the using of FIPA ACL as the foundation to reach the interoperability among several implementations of mobile agent between platform [10].

2.4 Ontology

Sebastien Picant and fabrice Bourge proposed a platorm mediation enabling partners to get involved directly in the exchange of business-to-business. This study presented a multy agent system developed by using JADE [11].

The agent communication can be carried out by using ACL Message and ontology [12] [13] [14].

3. Research Outcomes And Discussion

3.1 Communication between Agent and Ontology

The agent communication is carried out by using ontology known as CLOnto (Content Langauge Ontology) functioning to scheme the letter's information concept which will be used in testing this system.

Communication between agent and ontology

The communication between agent Master, agent work, and unit agent is illustrated in a seqenced diagram (Figure 1).

Content Language Ontology (CLOnto) that are being used are as follows:

1. Disposisi.java
2. DisposisiOntology.java
3. Status.java
4. Surat.java.

The example of this case is that when an LPM unit agent receives the letter of disposision from the director, he/she will then brings it to the director. As a result the directo will spontaniously ask whether it has been carried out or not.

The process of agent communication can be seen in the following Figure 1.

Communication Process

The result of the modelling on Figure 1 was tested in the form of application simulation by testing each behavior of every agent by using additional tool such as *Agent Sniffer*.

The implementation of this model can be carried out by using Netbeans 6.9.1 tool and Jade 4. The process of disposition letter is assumed to have been given to the other unit beyond the departments going to be discussed in this research.

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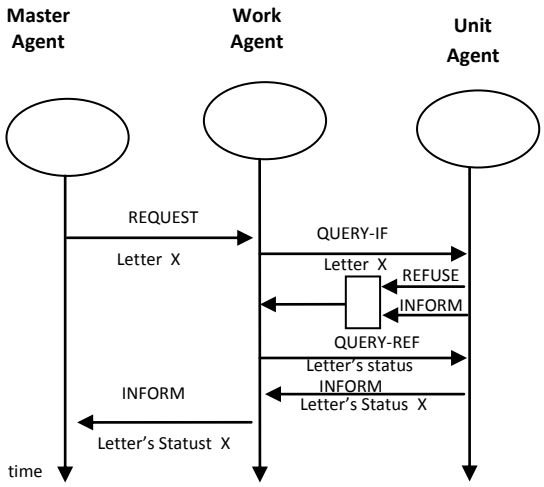

Figure 1. The order of agent communication.

The Phase of Communication Process

1. Making Unit Agent

There are two agents made: Unit Agent (LPM agent) and Unit agent (work Agent).

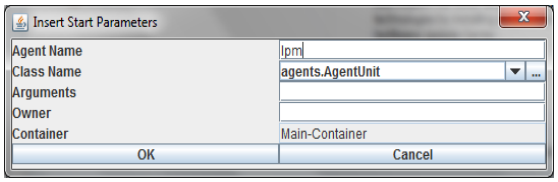

Figure 2. Making LPM agent.

In making LPM agent from the *main-container*, as seen in Figure 2, the class name is chosen as *agents.agentUnit*. LPM(*Beuro of Quality Assurance)* agent is a unit agent that receives the letter of disposition. The work agent is also made on the same way. LPM agent and working agent are in the same platform (Figure 3).

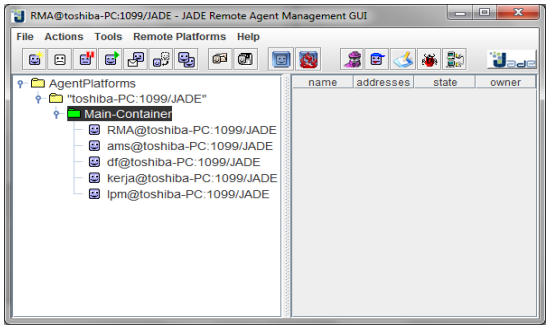

Figure 3. Working agent platform.

2. The Communication between the work agent and LPM agent

Master Agent da0 (dummy) asks the work agent to search the letter of disposition (Figure 4).

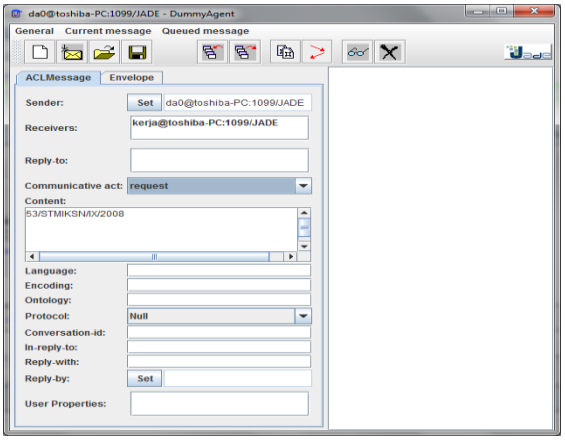

Figure 4. The communication between Master Agent and Work Agent.

The work agent then searches for the letter in all agents available in the same platform (Figure 6), in this case, the letter is in the LPM agent. The process of communication between the work agent and lpm agent is illustrated in Figure 5.

It is assumed, in this sample, that the letter of disposition being searched for is in the lpm unit (is stored in lpm unit), so the communication that takes place is between work agent and lpm agent. Being asked for the number of the letter by the work agent, the unit agent then searches for the wanted letter (the previous letter of disposition) to the lpm database and finally finds it there. The searching result of the disposition letter based on the number of the letter then is reported back to the work agent and is continued to the master agent (the director).

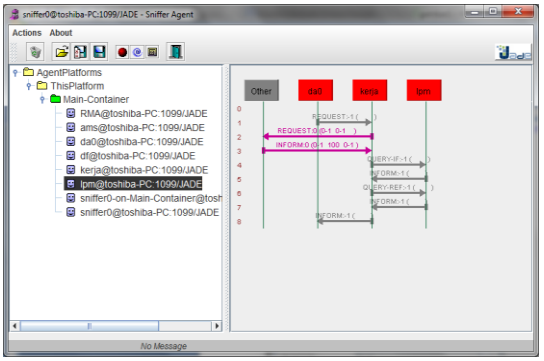

Figure 5. Sniffer from the work agent's process of communication in searching for the letter of disposition.

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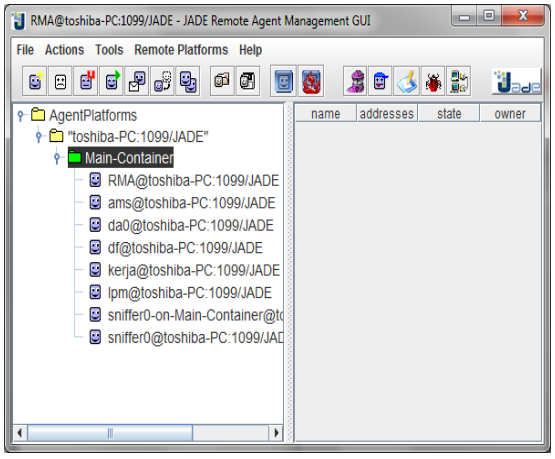

Figure 6. Work agent and LPM agent are in the same platform.

The communication from work agent to DF (Direktori fasilitator): REQUEST.

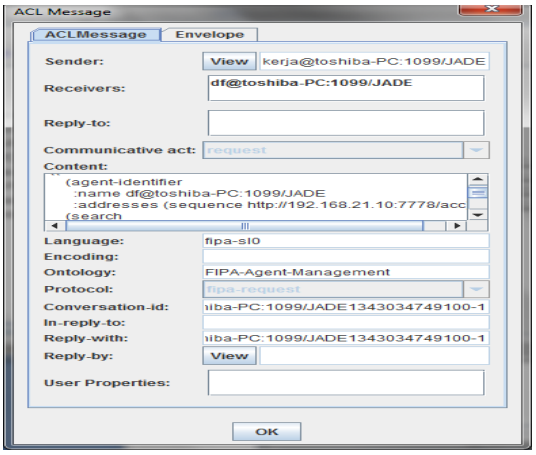

Figure 7. The communication from the work agent to DF (Direktori fasilitator): REQUEST.

The meaning of the communication of the work agent to the DF (Direktori Fasilitator) is that the work agent requests any agents in the same platform (Figure 7). It is assumed that there is another agent available beside the LPM agent.

```
((action
     (agent-identifier
       :name df@toshiba-PC:1099/JADE
       :addresses (sequence
http://192.168.21.10:7778/acc))
     (search
       (df-agent-description
         :services
           (set
             (service-description
               :type unit)))
       (search-constraints
         :max-results -1))))
```

The communication from DF (Direktori Fasilitator) to the work agent : INFORM

```
((result
     (action
       (agent-identifier
         :name df@toshiba-PC:1099/JADE
         :addresses (sequence
http://192.168.21.10:7778/acc))
       (search
         (df-agent-description
           :services
             (set
               (service-description
                 :type unit)))
           (search-constraints
             :max-results -1)))
     (sequence
       (df-agent-description
         :name
           (agent-identifier
             :name lpm@toshiba-
PC:1099/JADE
             :addresses (sequence
http://192.168.21.10:7778/acc))
         :services
           (set
             (service-description
               :name disposisi-surat
               :type unit))))))
```

The communication from the work agent to lpm (agen Unit) : QUERY-IF

```
((Disposisi
     (Surat
       :nosurat "53/STMIKSN/IX/2008")
     (agent-identifier
       :name lpm@toshiba-PC:1099/JADE
       :addresses (sequence
http://192.168.21.10:7778/acc)))
```

The communication from lpm ke the work agent: INFORM.

```
((Disposisi
     (Surat
       :nosurat "53/STMIKSN/IX/2008"
       :tglsurat "2008-09-21"
       :perihal "Surat Tugas Seminar
Pelatihan Auditor")
     (agent-identifier
       :name lpm@toshiba-PC:1099/JADE
       :addresses (sequence
http://192.168.21.10:7778/acc)))
```

The communication from the work agent to lpm:QUERY-REF.

```
((iota ?x
     (Status
       (Surat
         :nosurat "53/STMIKSN/IX/2008"
         :tglsurat "2008-09-21"
         :perihal "Surat Tugas Seminar
Pelatihan Auditor") ?x)))
```

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The communication from lpm to the work agent:INFORM

```
((=
     (iota ?x
       (Status
         (Surat
           :nosurat "53/STMIKSN/IX/2008"
           :tglsurat "2008-09-21"
                          :perihal "Surat
               Tugas Seminar Pelatihan
               Auditor") ?x)) "telah
               dijalankan"))
```

The communication from the work agent to da0:INFORM.

3.2 Tracking by using mobile agent

Determine every agent's own formats and individual roles that has mobile capability in his environment. The communication format between agent and agent reasoning model by using relational database as its source is illustrated in Figure 8. Meanwhile, the environment uses multi-platform model whose each platform must be able to accomodate the work of agent's role that can mobilize every individual agent to run his task.

The platforms involved in the research simulation, beside the original platform, are also those from other units such as BAU, BAAK, and Finance. The role of the disposition letter will be carried out by agent in the original platform (where the disposition letter originally comes from) and unit agent in other platform.

The model of the disposition letter process is explained in detail in the following:

The agent specifications are:

1. The Director
   a. Looking for the disposition letter status by asking it to the master agent
   b. Receiving the searching result from the master agent
2. Master Agent
   a. Receiving the instruction from the director about the disposition letter status
   b. Continuing the instruction from the director to the work agent about the searching of the disposition letter status. (Action:DELEGATE)
   c. Reporting the disposition letter status to the director (client) through interface
3. Work agent (mobile agent)
   a. The mobile work agent migrates to his proposed unit: BAAK Unit, BAU Unit, and the Finance unit.
   b. Searching the status of the disposition letter to the unit agent (Action:CHECKSTATUS)
   c. Receiving the information report of the disposition letter status from the unit agent.
   d. Reporting the letter's status to Master agent.
4. Unit Agent
   a. Receiving the disposition letter
   b. Running the disposition letter (changing the letter's status)
   Example:
      a. BAAK Agent (unit 1)
      b. BAU Agent (Unit 2)
      c. Finance Agent (Unit 3).

The design of the disposition letter searching is illustrated in Figure 8.

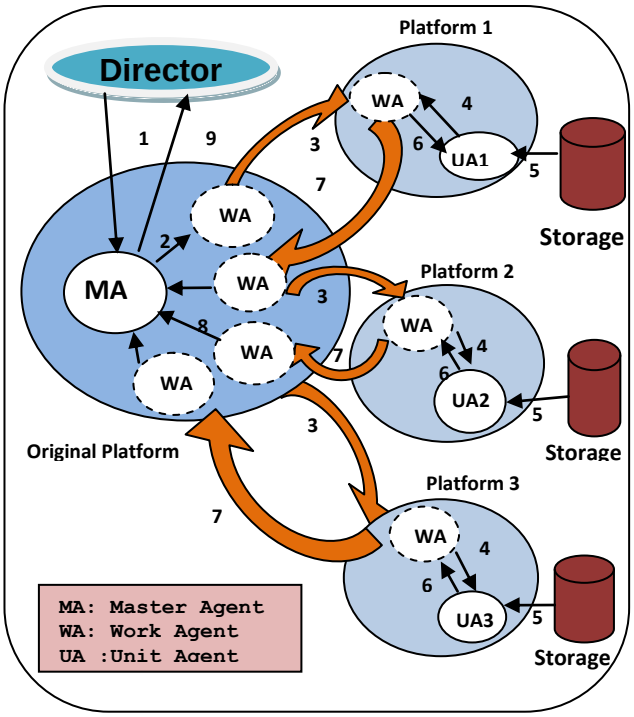

Figure 8. The searching of the disposition letter.

Example Process:

1. The director instructs the master agent to find out the status of the disposition letter based on its number.
2. The master agent delegates the instruction to the work agent.
3. The work agent migrates to other platforms in every unit such as BAAK, BAU, and Finance in a Star method
4. The work agent asks each unit agent in BAAK, BAU and Finace to search for the status information of the wanted disposition letter.
5. Unit agent 1, 2, 3 are searching the status infomation of the disposition letter in the storage in every unit (platform)

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6. The searching result that is the status information of the disposition letter (1:being executed, 2: not executed yet) from each unit agent; 1, 2, 3 to the work agent.
7. The work agent reports the searching result to the coordinator agent to the origine platform.
8. The coordinator agent reports the result of the letter's status to the master agent.
9. The master agent continues the report to the director.

The simulation of the disposition letter searching model can be seen in Figure 9.

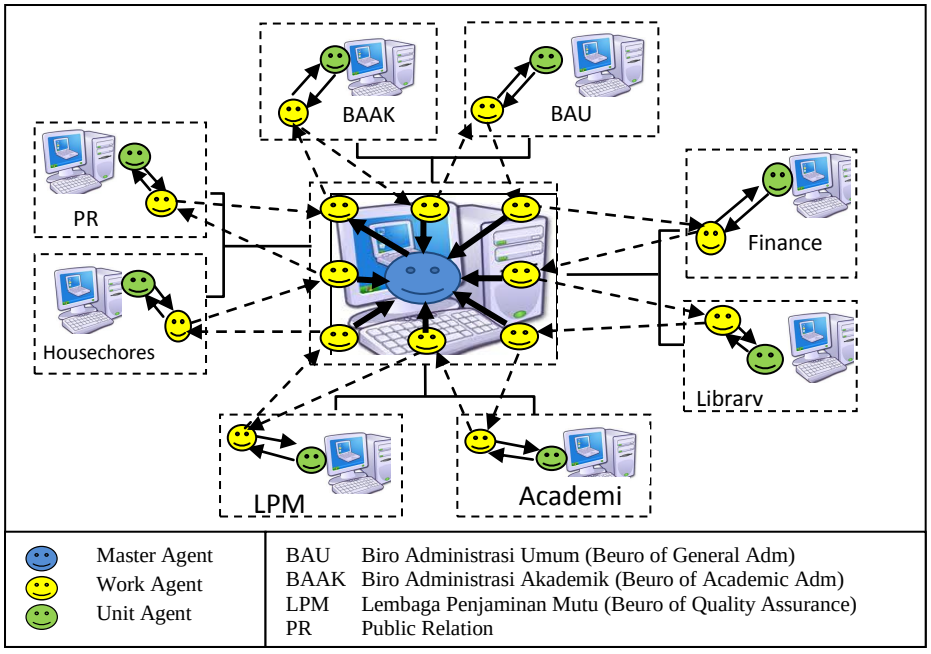

Figure 9. The disposition letter searching model.

Mobile agent with Ontology

This mobile agent uses ontology. Ontology of the disposition letter is illustrated on Figure 10, while mobile agent is illustrated on Figure 11.

Testing

The testing is trying to analize the document archives schemed into relational data model. The information of the disposition letter will be saved in the relational database under the name of archive consisting of two tables, they are table of letter which is used to save the data of the disposition letter and the table of disposition letter that will be used to save the information about it.

The testing is carried out in a laboratoy by using a computer whose specifications are: P4 3.06 GHz, Mainboard Intel, RAM DDR2 512 Mb, HDD 80 Gb Seagate, VGA onBoard.

Each Host is given an IP number, host 1:BAAK 10.0.3.131, host 2:BAU 10.0.3.132, host 3:Keuangan 10.0.3.134, host 4:Perpustakaan 10.0.3.135, host 5:Akademik 10.0.3.136, host 6:LPM 10.0.3.143, host 7:Kerumahtanggaan 10.0.3.144, host 8:Humas 10.0.3.152.

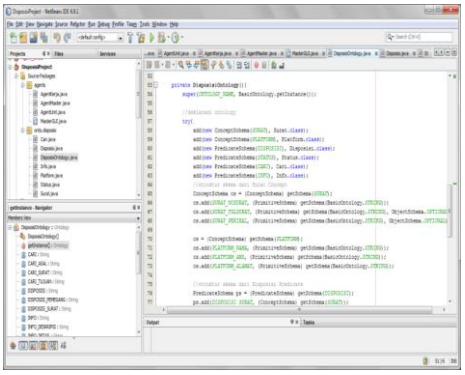

Figure 10. Disposition Ontology.

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The computer for the master agent and the work agent are specially provided for them as seen in Figure 12.

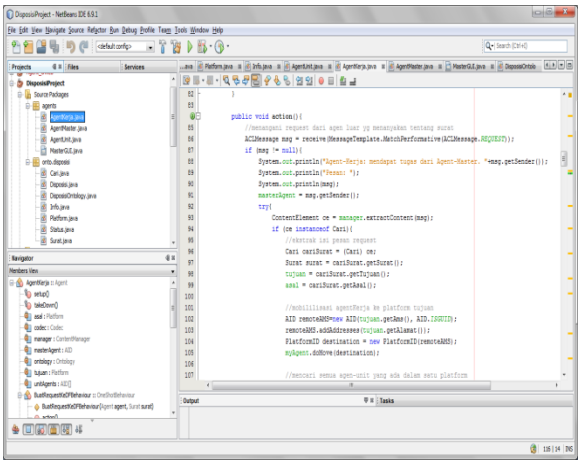

Figure 11. Mobile agent (work agent).

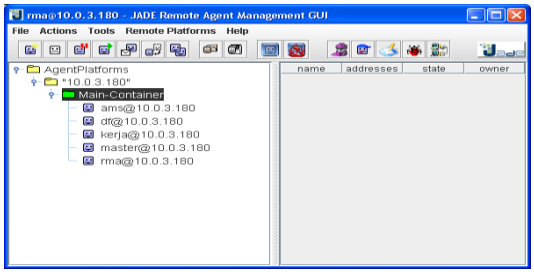

Figure 12. Manajement of JADE agent.

The display of Figure 13 will appear when the work agent is activated/made and then it determines the host going to be visited by inputing its IP number.

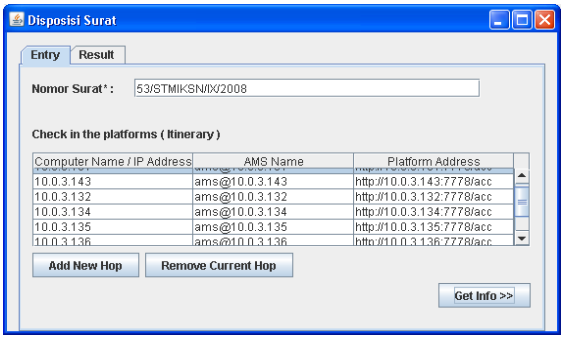

Figure 13. The display of the host address being visited.

The process of the searching execution is by pressing 'Get Info' on Figure 12, then the next process is that the work agent will browse the host that have been determined and count the time needed for the tracking result. The counting for each number of hits is carried out repeatedly as much as 5 times. The time needed for the tracking result is seen in Figure 14.

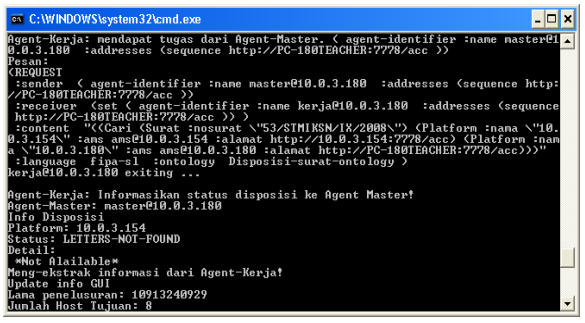

Figure 14. The display of the tracking result by the 8 hosts.

The average result of time counting needed for tracking the disposition letter is illustarted in Table 1.

Table 1. The time for the tracking of the disposition letter

Number of Platform	Time (seconds)	Time difference (second)
2	3,942	
3	5,260	1,318
4	6,681	1,421
5	8,118	1,437
6	8,469	0,351
7	9,703	1,234
8	10,957	1,255

The position of the disposition letter in this research is in host 6:LPM. The tracking is started from the host' smallest number to the biggest one.

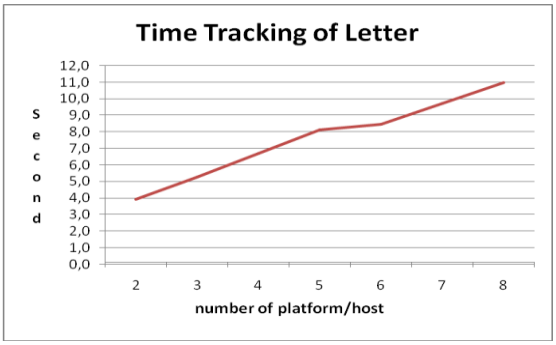

Figure 15. result time tracking of the disposition letter

The counting result of the time needed for browsing the disposition letter in this research is illustrated in Figure 15, showing that the more often a host is visited the more

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time is needed. The time needed to reach host 5 that increases linearly shows that the addition of the host total number will also significantly increase the time in almost similar number. After passing host 6 in which the disposition letter is there, there is a slowing down on time showing that there is a possible shorter communication between the work agent and the LPM agent because the wanted information is directly found out. The needed time for host 2 until 6 and 6 until 8, including host 6, shows that there is a less increasing of time than from the host under 6. It is proved by the existence of the slowing down on time in host 6.

4. Conclusion

Mobile agent can migrate to other platforms with specific purpose. The migration system and the mobile agent communication in the process of tracking files of the disposition letter between each platform have been modelled. Every agent has his own capability to communicate with the other agents. An agent can do his own role autonomously and can migrate to other platforms. The modelling of the collaboration system of every agent's capability to communicate uses ontology and the migration in tracking the files in a distributed network with a relational database have been simulated.

Future Works

This researched is hoped to be able to be developed on several issues such as enlarging the scope of the platform network being used, counting the level of efficiency of the agent migration to several different platforms, and how if there is failure during the agent migration to the other platforms.

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