A Design of Intelligent Agent for Research Reminder and Logbook using GAIA Method

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***Abstract*—This research aims to design an intelligent agent that can provide the reminder, receive, and manage the logbook research. The system will be built is can be accepted the input through form of research schedule information via the website interface, and send the reminder to user via SMS gateway. The Agent will send the reminder based on schedule activities, conducted the logbook, and provide a report when it requested. GAIA (Graphical Analysis for Interactive Assistance) method used for the analysis and design of agents. This method consists of two main parts, namely: 1) Analysis, aims to analyze role models, and analyze models of interaction model; and 2) design, which is to agent models, services model, and acquaintance models. The results of this work are: 1) The analysis of a collection of system requirements, 2) analysis of environmental models, 2) role models, 3) interaction model that includes: a) the association relationship between objects and their interactions, and b) the message exchange model between researchers and agent, 4) a model class diagram, and 5) the design system.**

***Keywords*— Intelligent agent, logbook, reminder, GAIA Method.**

I. INTRODUCTION

In doing some research, make a logbook or book Diary Research (BCHP) is essential in order to implement good management practices research and for the affairs of IPR protection. Furthermore, it states that "The logbook will be meaningful if properly filled. Charging the logbook not only for scientific purposes, but also can be used for legal evidence. Logbook will be required when filing a patent or other intellectual property protection to face objections from the other side of the property which is requested protection "[1]. Therefore, the management / management logbook good, very relevant to do.

For the example we have interviews with the management of research institute of Universitas Ahmad Dahlan Yogyakarta, Indonesia, that still about 20% of researchers in UAD not noticed logbook well. This reasarch proposed an alternative solution in the management of reasarch logbook that used an utilize artificial intelligence known in computer science, especially the implementation of the concept of intelligent agents. With given a certain knowledge, intelligent agents can automate and manage the reminder of the research progress of research logbook. Thus, with the construction of the system with the concept of intelligent agents will make it easy for research institute to conduct research and facilitate the control of researcher, because it helps manage the logbook reminder of the research and research activities that must be completed.

In this paper will be presented a description of the design of intelligent agents using GAIA method for reminder and logbook research using the Unified Modeling Language (UML).

Research intelligent agents have been done by some researchers to the character or level of ability of diverse agents. Among them are the buyer's agent behavior research design with multi-objective optimization approach uses an algorithm MOEA (Multi Objective Evolutionary Optimization) [2]. The concept of multi-criteria on the agent in this study are based theory Constraint Satisfaction Problem (CSP). The results of this study, a buyer's agent has a multi-criteria to decide "buy, negotiate or do not buy".

Intelligent agents approach (multi-agent) in the coordination of protection to improve the reliability and continuity of electrical services industry has also been carried out [3]. By using a multi-agent approach, the coordination between the protection relays are made sequentially by setting a certain time, so that the areas affected by outages can be minimized. The research focus is on the coordination of overcurrent relay interlocking devices are added. In this work, there are two agents that communicate with each other, namely relay agent and equipment agent. By replacing some of the relay settings and application of multi-agent approach on Industrial Electrical Systems, the reliability and continuity of service will be better power. Intelligent agent as a decision maker in the urban forest health monitoring with the utilization of Simple Additive Weighting (SAW) method, already conducted, and the result is the model of intelligent agents who can assist in determining the health level of urban forest [4].

Other related works were done by researcher, including built of intelligent health and decision support agent (iHANDs) with various artificial intelligence mechanisms [5], hinterland waterway barge transport planning using agent-based information integrated platform [6], intelligent agent based model results in excellent throughput, good response time and increases the QoS requirements [7], intelligent agent based defense architecture for DDoS attacks [8], multi-agents model to help drivers in finding a parking space at anytime and anywhere [9], analyzing consumer-to-Cloud and Cloud-to-Cloud interactions [10], implementation of controllers for stand-alone microgrids [11], load distribution among the agents in cloud computing [12], use agents for negotiation of host to host meeting scheduling [13].

Multi-agent system is used to change the preferences given by the user in the form of letters, numbers and special characters (text) into the structure of the database and extract the necessary information with certain keywords [14]. Agent is incorporated in the design of the system architecture is a combination of multi-agent Framework-system (MAS) and the MAS with Learning Framework (MAS-L). Framework MAS reduce development time and complexity of the implementation of software agents. Framework MAS-L combines intelligence and learning characteristics.

Previously, also never made use of a multi-agent approach as software development solutions in ensuring the survival of

the software [15]. Utilization of intelligent agents in this research is to offer a concept to avoid the expiration of the software life faster. Each existing task, delegated to the agent, which intelligently manage knowledge, and contribute to other agents, then when there is a change in the surrounding environment, only agent who related can be supplemented or modified knowledge and work, without having to disturb the other agent. So that the survival of the software will be longer.

II. METHOD

A. System Architecture

The design of the system architecture is presented on Fig. 1. The agent communicates with the environment through the internet and short message service (SMS) gateway.

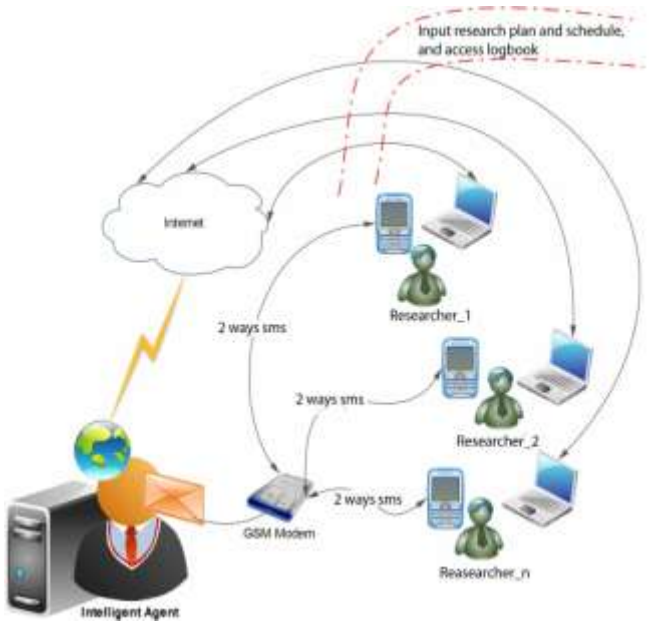

Fig. 1. System architecture

By utilizing the internet connection using web interface, the agent receives research plans, and provide research report logbook. SMS gateway is used by agents to deliver reminder to researcher about research schedule that mus to do, and receive input from from the environment, formly a record of research activities through SMS messages that sent by the researcher.

B. GAIA (Graphical Analysis for Interactive Assistance) Method

To analyze and design the intelligent agents in this work we used GAIA method. Diagram of GAIA method that shown in Fig. 2 is a modification of Zambonelli *et al*. [16], which consists of:

1) Collecting needs, including logbook variable, variable schedule of research, as well as reporting requirements
2) Analysis, include:
   a. Analysis environmental model,
   b. Preliminary analysis for task models (preliminary role model), and
   c. Preliminary analysis of interaction model
3) Design the architecture, namely:
   a. Model assignments (role models)
   b. The model of interaction (interaction model)
4) Detailed design, include:
   a. Agent models
   b. Services model

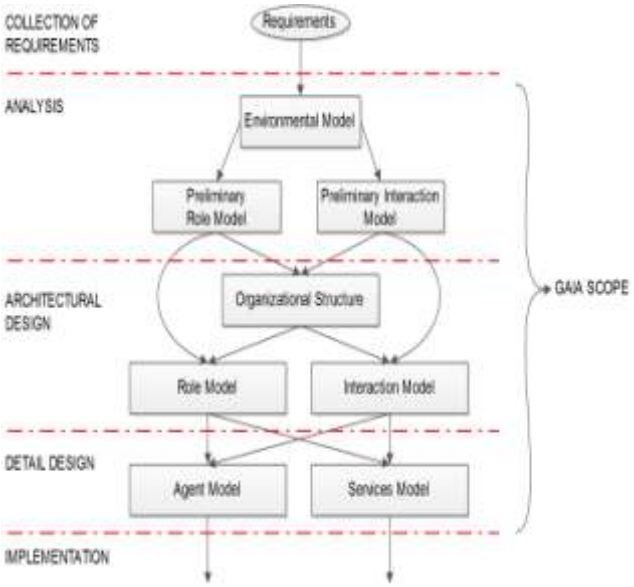

Fig. 2. GAIA method modified from Zambonelli *et. al* [16]

III. RESULTS AND DISCUSSION

The results and discussion in this research as follows:

A. Requirement analysis

Requirements grouped into three categories, including: functional requirements, non-functional requirements, and affective requirements [17]. Both non-functional requirement and affective requirement wil described in this section, and functional requirement defined system functionalities will describes in section of system sesification. Collection of research that needed include variable logbook, variable schedule of research, as well as reporting needs. Variable logbook refer to Reaserch Institute of Univeritas Ahmad Dahlan, which consists of: The Month, Number, Date and time, Activities, and progress notes (containing the data obtained, the data description, sketches, drawings, a brief analysis, etc.). Variable schedule consisted of a number, activity, and the month. The Reasearch and Researcher identities consist of Research title, Division of Science, Research category, type of research, researchers Identity (reasearcher chair, the number of researchers, investigators member name), research periode, study site, and the cost of the reasarch.

B. Role Model

Usecase diagram of Fig. 3 represents a tasks that performed by the actors involved in the system. In the usecase involves

two actors are researchers and agents, each of which has several tasks that can be done.

Tasks of actors, include:

1) Input research plan, a task undertaken by researchers to input data research plan;
2) Send the research plan, a task that is performed by the system to transmit data to the agent research plan. In use case, this task using the notation << extend >> which indicates that this task can only be done if the task has been carried extend;
3) Access to research logbook, a task that is done researchers to see the data logbook research progress;
4) Check logbook, a task undertaken by the agent to check the logbook that the data have been reported by researchers, and then retrieve the researcher. This Task use the << include >> notation, which means that task required by requested task, in order to the task can be executed;

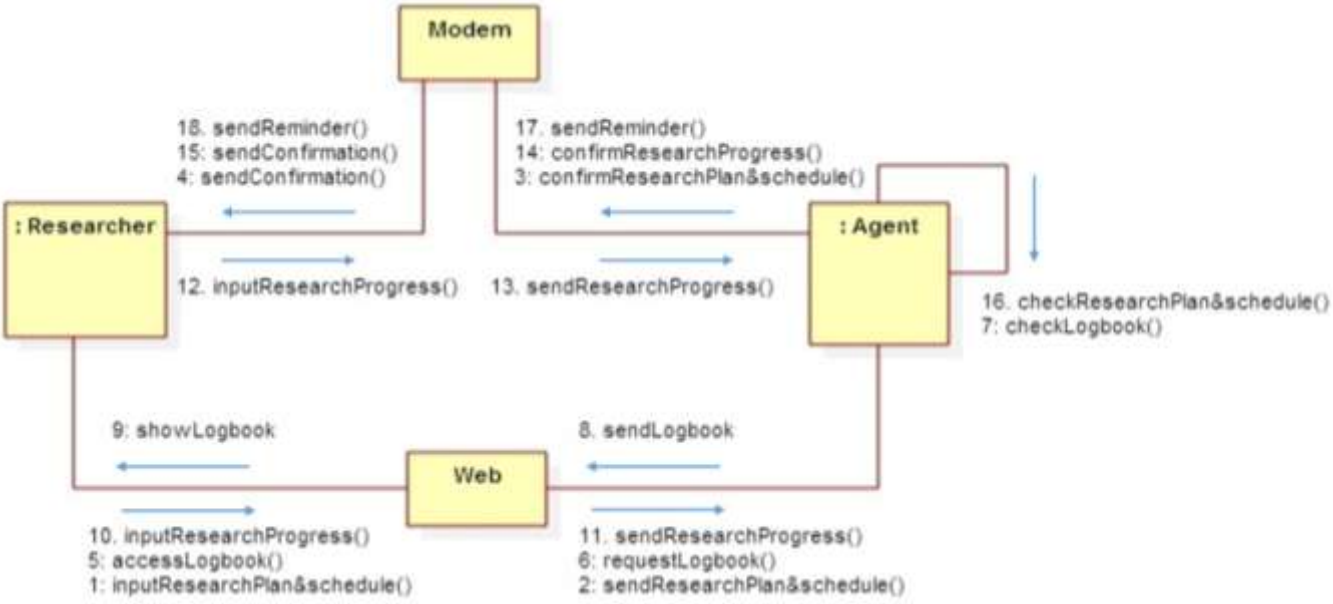

Fig. 4 Association between objects and their interaction

5) Input a progress report, a task undertaken by researchers to input data research progress report;
6) Send a progress report, a task that is performed by the system to transmit the data report progress to the agent. This task also use << extend >> notation. Task as well as in point 2;
7) Reminder reasearch, a task that is performed by the agent to the researcher to interact in providing information on the activities that have been planned to be immediately implemented. While the system environment in this usecase is the internet and Modem as a medium used by researchers and agents to interact.

Fig. 3. Usecase for agent and researcher interaction

Interaction Models

1) Association between objects and their interaction

Collaboration diagram shon in Fig. 4 represents the association relationship between objects in the system and their interactions. In goal is almost similar to the sequence diagram that shows the interactions between objects with other objects in a message sent, just not show direct relationship between these objects. In the diagram above shows that each object has a relationship with other objects to perform a number of interactions on a message that sent

2) Message exchange between agent and researcher

Sequence diagram (Fig. 5) represents a series of messages that sent by the object giving the message to the receiving object and also the interaction between objects in the system as well as the length of time the message was sent.

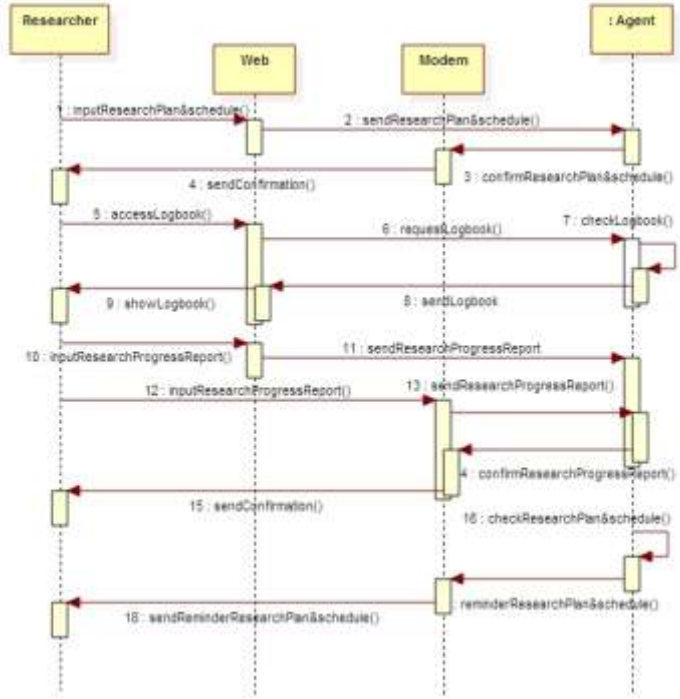

Fig. 5. Message exchange between agent and researcher

The following is a description of the flow of messages in a sequence diagram which illustrating the interaction of the agent with researchers.

The message sequence Fig. 5, also can describe on Table 1 to determine who sender and receiver and time (t) for each message in cycle of communication between researcher and agent through both medium internet (via web) and GSM network (via modem).

In sequence 1, researcher send the input research schedule and received by web, in seq. 2 then web send research schedule to agent. The time that used for this message sequence is 1 for each seq. 1 and seq. 2. The cycle end until the Seq. 18 (table 1).

TABLE 1. MESSAGE ON SEQUENCE DESCRIPTION THAT DESCRIBE THE INTERACTION

Message Seq.	Message	Sender	Receiver	Time (t)
1	Input research schedule	Researcher	Web	1
2	Send research schedule	Web	Agent	1
3	Confirm research schedule	Agent	Modem	1
4	Send confirm research schedule	Modem	Peneliti	1
5	Access logbook	Researcher	Web	1
6	Request logbook	Web	Agent	3
7	Check logbook	Agent	Agent	1
8	Send logbook	Agent	Web	1
9	Show logbook	Web	Researcher	1
10	Input research progress	Researcher	Web	1
11	Send research progress	Web	Agent	1
12	Input research progress	Researcher	Modem	1
13	Send research progress	Modem	Agent	3
14	Confirm research progress	Agent	Modem	1
15	Send confirmation	Modem	Researcher	1
16	Check research schedule	Agent	Agent	1
17	Reminder research schedule	Agent	Modem	1
18	Send Researach schedule	Modem	Researcher	1

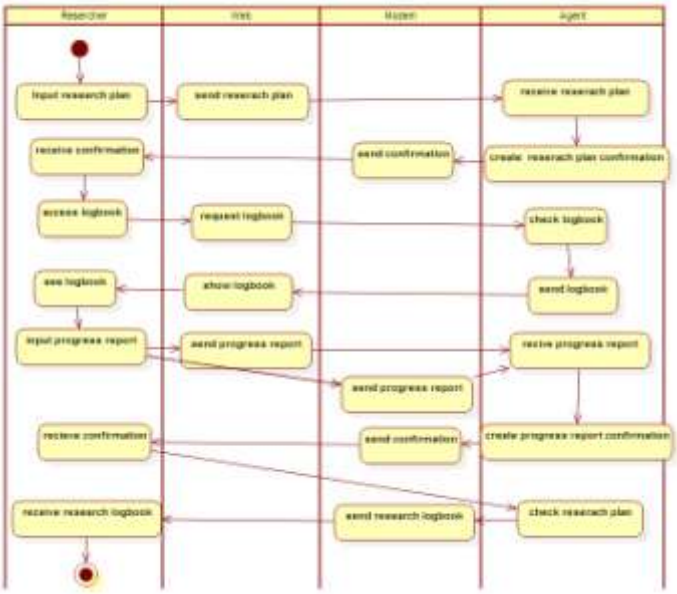

Fig 6. Activity diagram depicting the details of interaction between researchers and agent

Activity diagram on Fig. 6 represents a business process workflows and sequence of circumstances or activities conducted by the objects in the system from the beginning of the task has done until the end of the task. Sequence task is almost the same as in the sequence diagram that has been described previously initiated from the task "input research plan" and ending on the task "recieved research reminder".

C. Class diagram

Class diagram on Fig. 6 represents classes in the system along with a subset of and relationships between classes. In this system there are four classes include:

1) Study, a class of information relating to research data in general and also the data of researchers;

2) Research plan, is associated with a class schedule or plan of activities in the research to be conducted;
3) Research MoU, is a class of data relating to the agreement for the research carried out which has been approved by each party;
4) Logbook progress, the class associated with the research progress report every time for conducted monitoring.

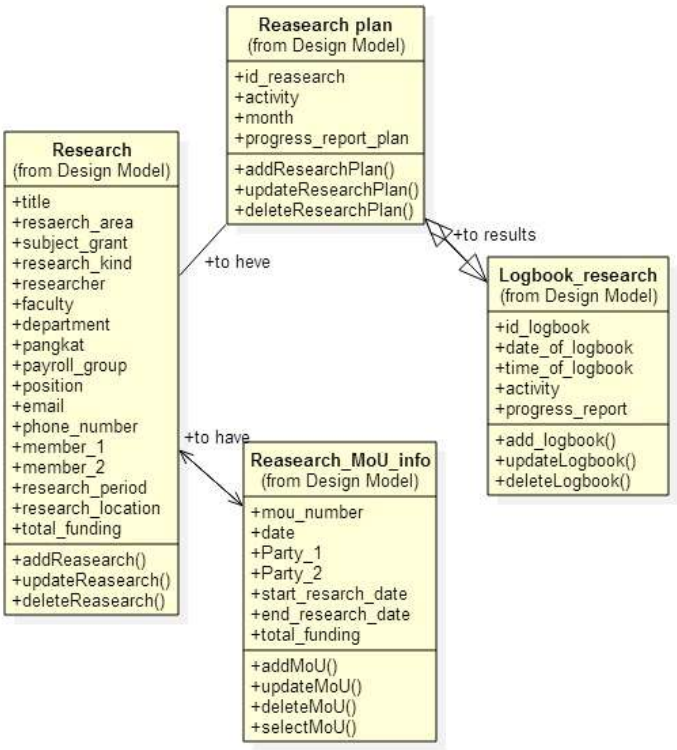

Fig. 6. System class diagram

Each class has attributes and operations that identifies from other classes and all of them have public visibility so there is no specific limit for the class in question accessed by other classes. For the relationship between the classes in the diagram above described that the class "research" related to class "research plan" and "research MoU" which means the attributes of each class has an ongoing relationship with each other. Then the class "research plan" also has a relationship with a class "logbook progress" with the type of aggregation relationships which means that a class is part of the other classes that can not be separated.

D. System specification

1) System functionality

Specification of system functionality that will be built in this research, include:

1) Researchers can entry the data through webseite interface
2) Researchers can submit research progress into the logbook system, through:

a. Mobile phones, with service short message service (SMS)
b. Website, researchers can create a new logbook records, update, and add the image, and other information necessary.

3) The system (agent) gives reminder based on the schedule that input by researchers.
4) Researchers can get the reports research activities while period the research.

2) System design

An application design that developed in this work used for management logbook for researchers who can input the research schedule and logbook research, the system will be given the reminder to researcher, and provides logbook report. In addition, interaction between users with the system through two alternatives, namely GSM network (mobile) and internet (website).

IV. CONCLUSION

From the description in the previous section can be deduced the conclusion are:

1. Researchers and agents can communicate via the GSM network and the Internet (via the web) to perform reminder and recording research progress (logbook).
2. The knowledge base that used in this system will be contains identity information agent research, research plan, research MoU, and the research progress (logbook)
3. The system output is the logbook for supporting the research report.

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