www.ijecs.in
International Journal Of Engineering And Computer Science ISSN: 2319-7242
Volume 4 Issue 9 Sep 2015, Page No. 14401-14405

Study & Analysis of Intention of a BDI Agent and its Performance

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Abstract: ***The reasoning ability is significant in an agent model and especially in BDI model. The belief, desire and intentions are the three important concepts in reasoning of the BDI agent. The response of a BDI agent is effective when the belief, desire and intention concepts are optimum. In this paper the efficiency of a BDI agent is analyzed by compelling the agent to dynamically revise the intention based on the perceptual input and achieve the target goal.***

Keywords: BDI model, perception, agent**.**

1. Introduction

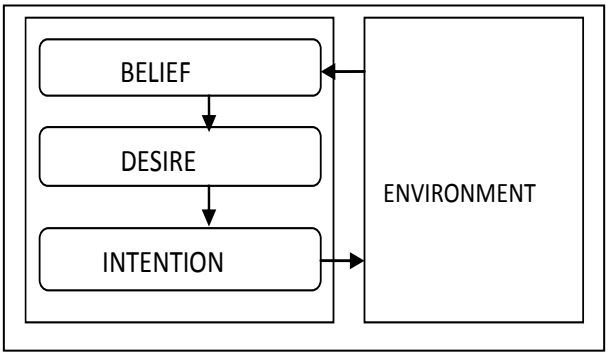
When The BDI model is one of the matured approaches used to build an agent. It is mainly based on logic and psychology and it focuses on symbolic representation such as belief, desire and intention. This model is preferred since its emphasis is on human practical reasoning, which is not only concerned about the goal but also concerned with the means of achieving them (AnandS. Rao and Michael P.Georgeff, 1995). The belief is the set of justified facts that the agent knows about the environment and itself, the desire is about the goal(s) that has to be achieved and intention is about executing the best plan, to achieve the goal. The environment is considered to be dynamic and the BDI agent developed to achieve a goal depends on the belief, desire and intention present at that particular instance. For instance, consider a BDI agent that is capable of picking weeds. Here, the agent believes that there are weeds and they can be plucked. Plucking all the weeds is the desire and choosing the appropriate path to reach the weeds from its source position, will be the intention. As mentioned earlier, the agent must be capable of responding effectively to the dynamic environment. In this case a dynamic environment can be an obstacle which might cover (block) weeds and the agent may not be able to reach the weeds. Hence, the agent should maintain appropriate parameters based on its belief to achieve its desire. Belief is considered to be a parent set from where the desire and intention are derived. Thus the belief should contain the facts about the environment that are justified, to arrive at a desired conclusion.

2. Related Work

There are not many papers about efficiency of BDI agent, but few of the papers have discussed about various aspects of efficiency .The efficiency of a BDI agent is discussed with respect to response time (Huiliang Zhang, Zhiqi Shen, Shell Ying Huang and Chunyan Miao, 2010) in which it finds how fast the agent is able to respond to the events. This estimate can be used for predicting the response time of an agent. This approach also helps in deciding on an agent in multiagent based on specific environment. In another paper they have considered efficiency by focussing on effectiveness of BDI agent.The agent has to be used judiciously and unnecessary usage may lead to performance overheads. Another paper expresses that a module called observation is also important along with belief, desire and intention to achieve a goal efficiently(Kaile Su, Abdul Sattar, Kewen Wang, Xiangyu Luo, Guido Governatori, Vineet Padmanabhan, 2005). It also insistes in considering multi values for B,D,I rather than a single value at a given instance.

3. Background Study

A BDI agent is a rational agent having certain mental attitudes like Belief, Desire and Intention (BDI) to continuously act to its changing environment. This model represents both the present uncertainty and future uncertainty.



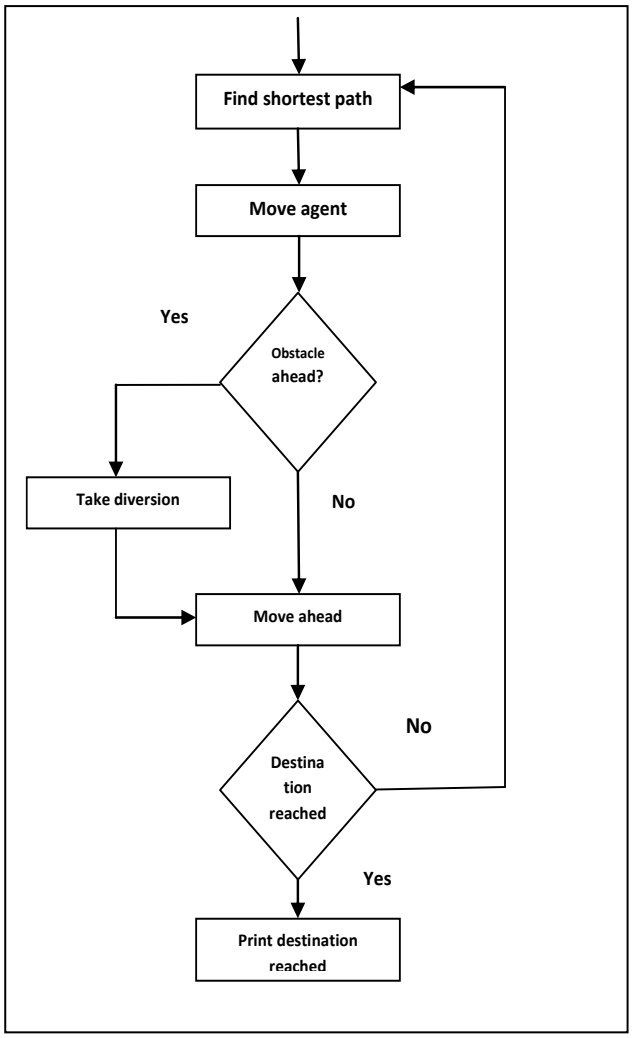


Figure 1: BDI Architecture

Belief– this is the set of information that is known by the agent about its environment and itself. As the environment is dynamic, the static data about the environment can be initially declared and dynamic information can be obtained by perceiving the environment.

Desire – the goal(s) that the agent should achieve or the motivational state of the agent is called its desire. This should be known previously to the agent.

Intention – the deliberative state of the agent is referred as intention. The best plan amongst the intended set of plans is obtained by eliminating choices inconsistent with current intentions.The traditional BDI has seen lot of influences over the time with various approaches but still it has to be commendably recommended(Georgeff, M., Pell, B., Pollack, M., Tambe, M. and Wooldridge, M., 1999).

Thus the agent considers all these aspects at a particular instance of time before reacting to the situation. Since the environment is dynamic, the belief set is prone to a number of changes and it will not remain the same in all cases. Hence, the agent should be capable to update its belief and execute the best plan (Andrzej Walczak, 2005) among the alternative plans based on its belief to achieve its goal.The belief at a particular instance influences the intention. If there is maximum information available about a particular environment, then the possibility of arriving at the desired outcome is higher. Thus, intention and belief are directly related to each other.

4. Problem definition

We are attepting to assert that the BDI agent efficiency depends on belief, desire and intention and also understand the impact of intention in achieving the goal through experimental analysis.

5. Design

The BDI agent is deployed in an environment wherein it has a number of objects(obstacles) which are both static and dynamic. The static object are positioned at a particular location(which is part of the belief) and it can be sensed and percieved by the BDI agent. Whereas the dynamic objects(obstacles) appear randomly in the environment (which are not part of the belief). The environment also consists of one single destination object that the agent has to reach. The goal of the agent in this environmental setup is to reach the destination by the shortest path(which is the intention) by overcoming the obstacles both static and dynamic. The agent should sense the object in the next position and moves to next position. Whenever the agent comes across the obstacles(static or dynamic) it should avoid it change the course and again find the shortest path from the current position to the destination (revise the intention)(Mehdi Shajari and Ali A. Ghorbani, 2004) (M. P. Georgeff and F. F. Ingrand, 1989)till it reaches the destination object.

Figure : 2 Algorithm for BDI agent to reach destination

6. Simulation test-bed

The testbed is implemented using SWI-Prolog and Prolog editor (Version 5.4.6). This experiment includes cognitive and engineering perspectives. The environment consists of various elements as shown in Fig 3. The various objects in the test bed include

1)Static obstacles

2)Dynamic obstacles

3)Destination

4) Agent

1 Static obstacles

These are the objects whose positions are predefined .When the agent encounters this object it should avoid it by taking a diversion. They are represented in green color in the testbed. These obstacles are declared as facts that establish the belief about the environment. In real world examples like avoiding land mines by a war tank, the static obstacles include the trees or rocks on its way.

2 Dynamic obstacles

These are the objects whose positions are not predefined. These obstacles are created within the environment at random positions. Hence these obstacles may obstruct the agent on its path to destination dynamically.

They are represented in red color in the testbed. These obstacles are not declared and is not part of the belief.

In real world examples like avoiding missiles, birds on the path of a airplane, the dynamic obstacles are the birds which might appear suddenly in its path.

3. Destination

Destination is a object which is created at a known position in the environment. Reaching the destination is the primary goal of agent. Destination is represented in blue color in the testbed . The agent moves towards the destination overcoming the obstacles on its path. If the destination is reached successfully by the agent a success message is printed on the status bar.

4. Agent

The BDI agent senses the next object and moves one position at a time.It avoids both static and dynamic objects and tries to reach the destination.

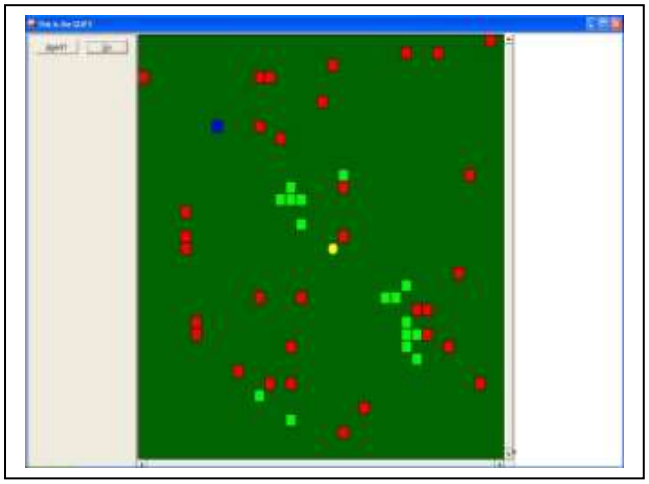


Figure 3: Snapshot of Test-bed

7. Experiment:

The simulation testbed is run using prolog The testbed environment displays a number of static objects. A BDI agent is created and start simulation. The agent perceives at each move and finds the shortest distance to the destination and moves towards the destination. When the agent perceives a static obstacle, it deviates its direction again finds the shortest path and moves as shown in Fig. 4. Since the dynamic objects are randomly generated they can appear anywhere anytime in the environment as shown in Fig. 5. The BDI agent has no knowledge about the location of the dynamic objects it just perceives the next position and moves, but there is always a possibility of the agent colliding with dynamic obstacles.

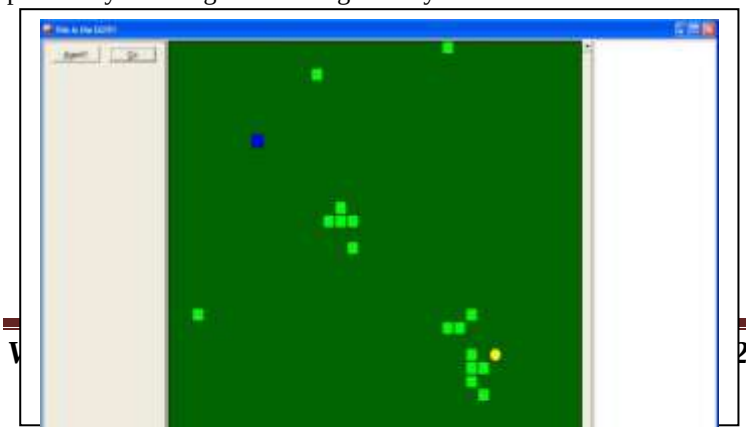
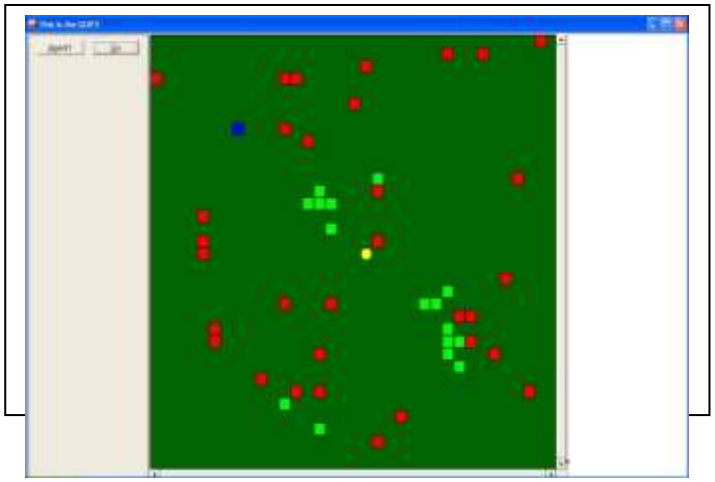


Figure 4: Snapshot of agent avoiding static objects



8. Result Analysis

The BDI agent is successful in reaching the destination avoiding both the static as well as dynamic objects on most of the occasions. When the simulation is run consecutively the BDI agent fails for one out of 15 iterations. The results are shown in the graph Fig.6 and the results data is displayed in Table 1. A comparitive study is also done by running an agent without replanning ability in the same environment.We found that the agent is not able to avoid the obstacles and reach the destination. We changed the location of the destination to five random locations, and in all five the agent was not able to reach the destination. But the BDI agent with replanning ability was successfully able to reach all the five the destinations avoiding all obstacles. The results are displayed in table 2 and the corresponding graph in Fig. 7.

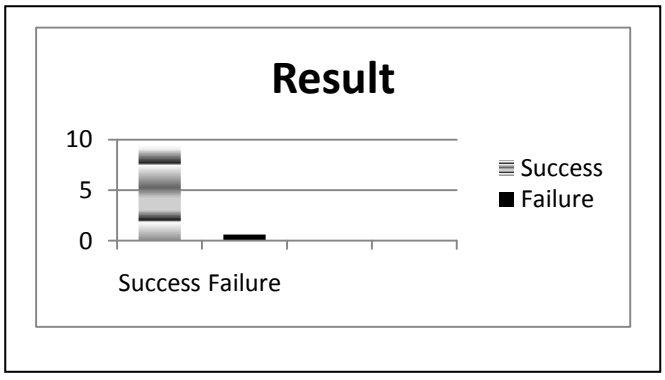


Figure 6: Graph showing the Success and Failure result

TABLE 1: Results of simulation

DOI: 10.18535/ijecs/v4i9.58

Instance -I	***Iteration***	1	3	5	7	9	11	13	15
	Result	Success	Success	Success	Success	Success	Success	Fail	Success
Instance -II	***Iteration***	1	3	5	7	9	11	13	15
	Result	Success	Success	Success	Fail	Success	Success	Success	Success
Instance-III	***Iteration***	1	3	5	7	9	11	14	15
	Result	Success	Success	Success	Success	Success	Success	Fail	Success
Instance-IV	***Iteration***	1	3	5	7	9	11	13	15
	Result	Success	Success	Success	Success	Fail	Success	Success	Success

TABLE 2: Results of simulation of BDI agent with Re-planning & without Re-planning ability

	Result				
Location	*L1*	*L2*	*L3*	*L4*	*L5*
BDI agent with Replanning ability	*Success*	*Success*	*Success*	*Success*	*Success*
BDI agent without Replanning ability	*Fail*	*Fail*	*Fail*	*Fail*	*Fail*

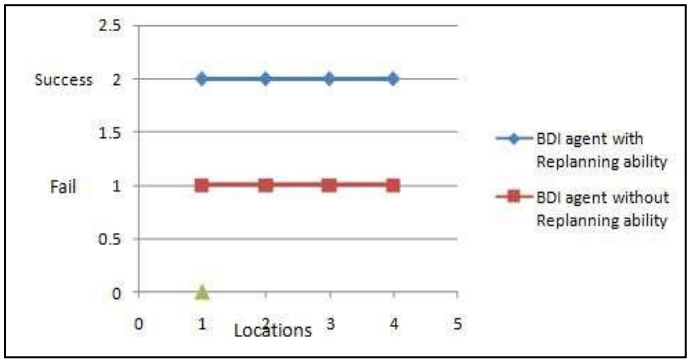


Figure 7: Graph showing the result of BDI agent with and without re-planning ability

9. CONCLUSION

We find from the experimentation that the BDI is able to change the intention(plan) accordingly whenever it required. So BDI agent acquires the knowledge which is the belief, it sets itself the goal or the objective which is the desire and the set of plans to achieve the desired goal which is nothing but theintention. The agent is capable of successfully re-plan the as required in the dynamic environment.

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Vishwanath Y received the B.E. in Computer Engineering from Mangalore University in 1998 and M.Tech in Computer Network Engineering from Visvesvaraya Technological University in 2005. He has been working as faculty for 12+ years in Computer Science & Engineering and Information Science & Engineering discipline. Worked as software Engineer for 3+ years in IT Industry.

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