A Dynamic Ontology based Model for Intelligent Robot

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***Abstract*— In recent year's ontology based intelligent agents have become capable to learn from their experiences. Although these agents can adapt to their environment but still they may face anomalies in hostile environment. These anomalies may lead towards poor adaptation as well as inappropriate action planning. Therefore we suggest dynamic ontology based agent model to learn from past experience for better action planning and adaptation in hostile environments.**

I. INTRODUCTION

Learning agents are developed, having capabilities to learn from their experiences and they can adapt to the hostile environment [3]. These agents preform actions on the basis of previous experiences. Many kinds of learning agents learning are based on the past experiences. And their activities are also depends on these experiences. Only past experiences are essential for action plan. It may face some sort of anomaly while perform actions on the basis of the previous experiences. Therefore if there are not present previous experiences related to the problem they cannot do anything or cannot perform work effectively. To overcome this problem ontology is introduced in the learning agents [4]. Ontology works like a graph, its nodes represents concepts and arc represents association between these concepts. It is the shared conceptualization that contains framework of specific domain knowledge, properties, attribute and theories about domain knowledge [1].

Recently many Ontology based agents are developed like CORA [2] RACE [3] OUR-K frame work [4].these agents reduce the above said issues and improve the performance. Most of ontological agents are based on the static rules and constraints [12]. They can improve their knowledge, enhance their previous experience, and adapt to the change environment [3].

But these agents only work in the static and consistent environment [7]. They cannot perform work in the dynamic and versatile environment and their nature is also not generic. Agents are only capable to perform defined and specific tasks [7, 10]. There architecture is also specific in nature [2]. These agents can improve its learning but they are not capable to enhance and improve previously present rules.

This paper proposed an idea to overcome the problem of static rules and static environment. Proposed model has feature of dynamic rules construction .And this agent may enhance their rules according to the environment and provide multiple suitable solutions for the situation. For example, to dig soil, there is defined tool, if these agents don't have such tools, it may analyze properties from knowledge base and previous knowledge. Define some rules and then find other tool or object that can be utilized for that purpose like "spoon" to dig the soil.

II. RELATED WORK

According to ORO [7], this architecture is based on symbolic storage of knowledge, reasoning and categorization. This learning agent deals with different ontology framework such as Jena framework, Pellet reasoned and Opencyc. It can tackle facts that are only based on consistent constraints.

OMRKF [6] based on four types of knowledge classes, axioms and two rules i.e. unidirectional rule & bidirectional rule. Each knowledge class has three layers. It's symbolic architecture performance good when dealing with simple tasks. But agent performance is reduced when dealing in complex situation.

Gi Hyun Lim [4], overcome the problem when agent performing complex task. Our-K system integrates low level data sensory motor with high level data. This frame work has the capability to work and finish its task when partial information is given. But when Our-K observes new objects it cannot generate new facts about this object.

In RACE framework [3], agent uses previous knowledge to complete required actions and for conceptualizations of situation.to accomplish this goal experiences take the structure of the saptio temporal. This agent needs the help of human/supervisor to realize the situation and relation between the objects. After the supervision it may be able to conceptualize the result. In the RACE unsupervised learning is not focused.

Edson Prestes [2] define collection of different ontologies; these ontologies are standard for representation of knowledge. This helps human and agent to communicate in specified environment. It generates sub ontologies of different fields. For example, problem should be related to define ontologies in other case inconsistency is faced.

III. COMPARATIVE ANALYSIS

In this section describes the comparative analysis of different models like ORO [7], OMRKF [6], OUR-K [4], RACE [3] and CORA [2]. All these models work in different framework and environments. These are based on different ontologies of conceptualization, relationship and semantic about objects of data [3, 4]. Here we define certain parameter and details of these are explained below.

Previous Experience: This parameter defines whether agent use the previous knowledge in situation or it has ability to extract the previous experiences [6, 11].

Integration of Low to High level data: It describes agent complete work effectively and it has coordination and association between simple task and complex task [7]. It may also determine, there is association between the information or not [6].

Sharing of knowledge: This defines agent share knowledge or whether it may able for categorization of data and have semantic of knowledge [16].

Improve rules & constraints: Agent contains the constraints about the different situations. This determines that learning agents have the ability to improve rules or not according to the situation.

Extending new knowledge: This defines that agent either be capable of increase its knowledge or not. Agent has the ability to update its knowledge or not [3].

Complex task execution: It may represents that agent have potential to perform complex task or not [4, 6].

Ontology suggests alternative solution: It defines that if previously defined rules are not fit in the environment, agent has the ability to suggest alternative solution to the problem situation as in the human beings.

ORO [7] is capable to utilize previously learned experiences in the new situations and renovated their knowledge. This framework does not discuss interface between simple and complex task. It also not defined sharing of knowledge between different learning agents. It does not focus on the improvement of rules and constraints. It allows statements to improve work only when environment is consistent. ORO is able to enhance its knowledge base and reasoning in these concepts. It cannot support to execute complex tasks. It cannot suggest alternative rules and solutions in the problem situation.

OMRKF [6] uses previous experiences for object recognition and space classification. It allows the interface between low to high level data and sharing of knowledge like facts and functions among different agents. It also cannot improve previously presents rules and constraints and it also cannot upgrade their knowledge. It is capable only to perform simple tasks and have not the ability to define alternative solution to the agent.

In OUR-K [4], it has ability to enhance previous experience and use this in the different situation when previous experience is required. It has also ability of correspondence between low to high data. It also cover the feature of sharing of knowledge between different learning agents. But it does not focus on different parameters like improvement of rules and constraints and up gradation of knowledge when encounter new situation. This also cannot execute complex tasks. This framework has not capable to describe and define new rules if existing ones are not working.

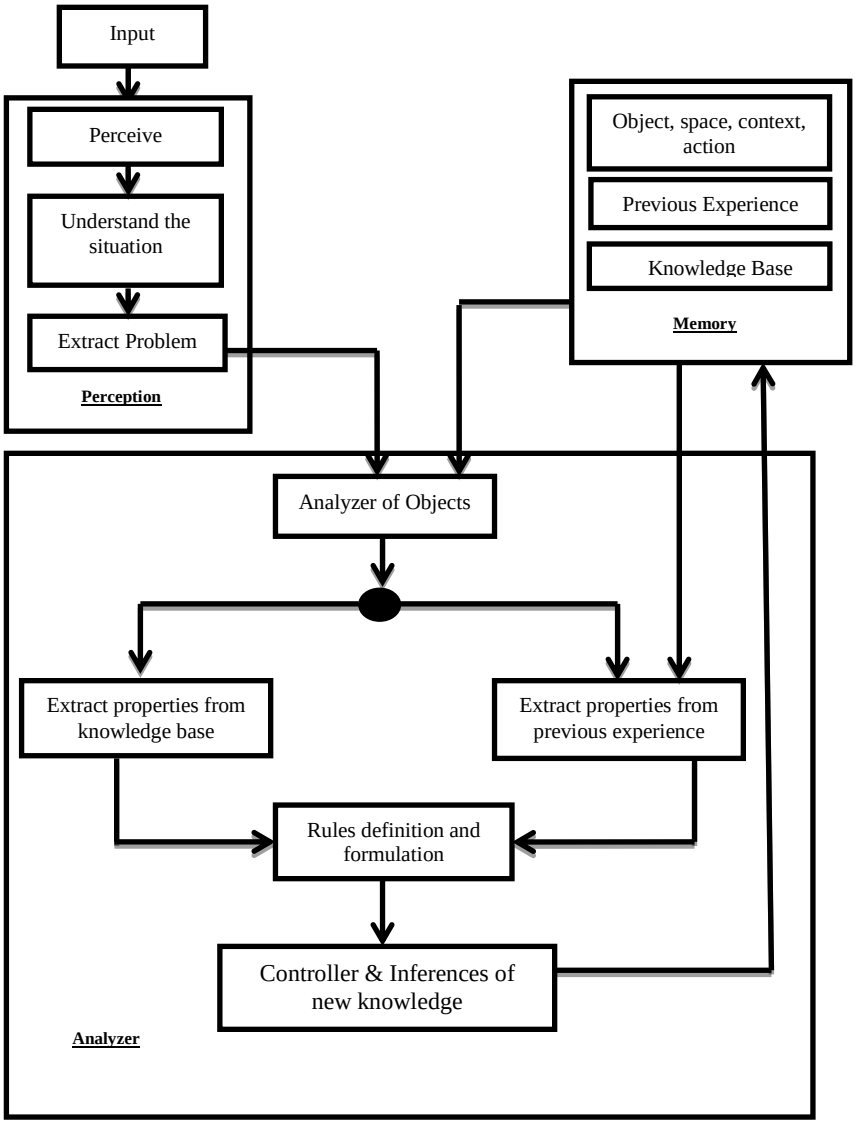
Like other models RACE [3] also suggest some aspects like learning from previous experiences, interface of low to high level data. It also discusses execution of complex task in different situations. RACE partially describe up gradation of new knowledge. This may not extends knowledge when starts work in unsupervised environment. RACE framework also cannot describe possible solution and rules for the problem situation.

CORA [2] does not discuss different features like interface of data at different level, improvement of rules and constraints in new problem domain. This also not described about extension of previous knowledge and complex task execution. It is only able to define about utilization of previous experience and sharing of knowledge in different domains. Like other agents CORA also not describe different solution to the problem.

	Previous experience	**Integration of low level association with high level of data**	**Sharing of knowledge**	**Improve rules and constraints**	**Extending new knowledge**	**Complex task execution**	**Ontology suggest alternative solution**
ORO	Covered	Not defined	Not defined	Not defined (Not support to inconsistent situation)	Covered	Not defined	Not covered
OMRKF	Covered(For objects recognition & space classification)	Covered	Covered(common concept like facts , functions)	Not covered	Not covered	Not covered (only simple tasks performed)	Not covered
OUR-K	Covered	Covered	Covered	Not covered	Not covered	Not covered	Not covered
RACE	Covered(For conceptualization & adapt the plans)	Covered	Not defined	Not covered	Partially described(cannot work in unsupervised environment)	Covered	Not covered
CORA	Covered	Not defined	Covered	Not defined	Not defined	Not defined	Not covered

TABLE I. COMPARISON OF MODELS

III. PROPOSED MODEL



Proposed model of Ontological agent

IV. PROPOSES MODEL DESCRIPTION

The proposed model works on the dynamic constraints, utilize its knowledge to improve rule and provide multiple solutions for the situation. But different ontological agents like ORO, OMRKF, CORA, RACE, OUR-K don't not the ability to improve their rules, these agents work on static constraints that cannot be further improved their rules and these agents also are unable to suggest the alternate solutions.

This paper proposed an ontological agent that can be able to improve previously defined rules and constraints and also have the ability to infer new rules on the basis of knowledge and previous learning .and on the basis of these rules new and already suggested solutions are generated .This ontological framework have the ability to learn from the experiences and infer dynamic actions collectively on the base of the experiences and knowledge base and store the new rules and its properties so that utilized when needed . This framework can infer rules in the situation which is not previously encountered and also work in the new environment. Like human beings concepts about environment, space, object, and context increased day by day.

This model is based on the layered approach. It contains three layers, first layer is the Perception [7], second layer is Memory and third layer is Analyzer. First of all agent receive input from the environment or with human interface. When agent gets input from the environment, robot perceives the input and understands the situation. Then extract the problem

features. After analysis of problem, problem moves in to the analyzer section which is the second module of this framework. If there are previous experiences relevant to the problem, extract rules from the previous experiences and in the second situation there are no previous experiences it evaluate properties with the help of knowledge description and knowledge association. New rules and constraints are formulated with the help of analyzer; previous experiences also help in the formulation of new rules. This model has advance feature that it has the ability to improve previously present rules. Then it can infer different kinds of rules, select suitable rules according to the environment. After this conscious agent implement this rule and store in the previous experiences. Memory basically consists of description of knowledge and associations of knowledge [4]. Knowledge representation defines about the different objects in the environment and knowledge association determines the semantics between these objects.

Memory contains three layers, first one is Object, space, context, action [4] second layer is previous experiences and third layer is Knowledge base. Object, space, context, action layer described in [4].previous experiences consists of previously performed actions and agents learning about the objects, space, their attributes and features. Third layer which is knowledge base layer it contains the general concepts and common sense about objects and environment. Knowledge base contains general knowledge about objects and environment. On the basis of object, space, context, actions, past experiences, knowledge base diverse and dynamic problems are solved. This can assist agent to enhance their knowledge, improve robot understanding to the environment. Agent generates constraints from the knowledge base when it is needed.

V. ALGORITHAM

1. Get input from the environment
2. Problem proceeds in the perception module.
   I. Understand the problem.
   II. Extract problem.
3. Analyze the problem objects from memory.
   If
   Previous experiences relevant to the problem
   Then

4.1 Extract rules from the previous experience
   Else
4. Previous experiences are not according to the environment
   Then
   It extracts relevant properties from the knowledge base
5. Define rules according to problem situation
6. List of rules are formulated
7. Select suitable list of objects according to the rules defined.
8. Store new rules in the memory e.g. experience, object, space.
9. Provide list of possible solution to the conscious agent to perform required action.

VI. CASE STUDY

An agent is works in the garden. Its goal is to dig the soil. First of all problem or situation goes in to the perception module. At this stage problem is problem is being defined and understood by the model. Such as the problem is how to dig?

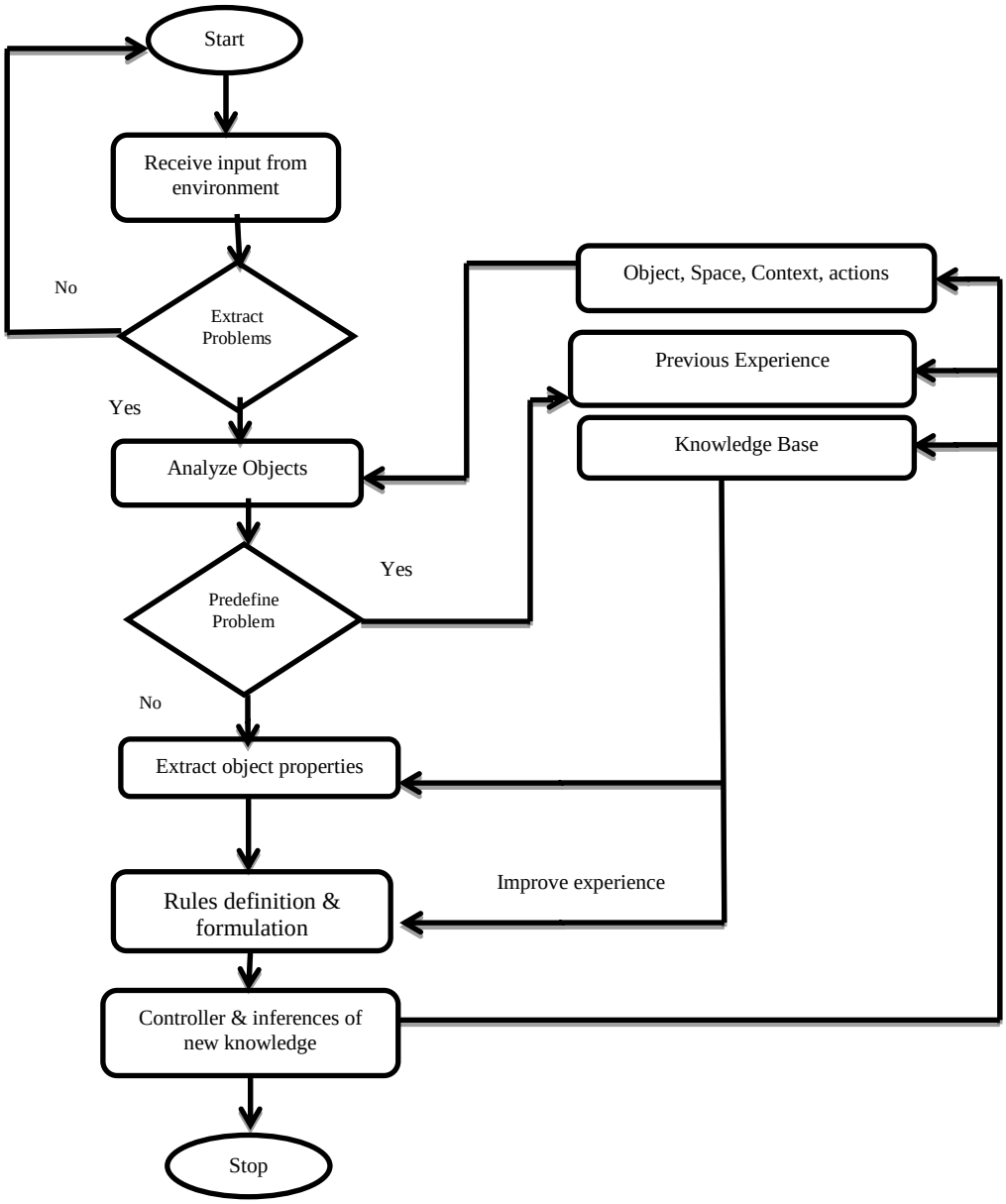
After perceiving the problem, it analyzes the knowledge base and find out what problem is and what object attribute and properties are necessary for the problem, meanwhile it also find the problem understanding from previous experience and the found properties and attributes are gathered with newly inferred properties from knowledge base and are treated as new rules. As in present situation tool have properties like hard and sharp. Then it checks whether there properties are present in objects a part from previous experience presented objects like objects for digging the soil having features sharp and hard. Previous experiences tell shovels for this purpose. And due to newly inferred rules list of objects is generated like knife, pen, spoon etc.

If agent fond that shovel is not available at that time. Then agent have list of objects (like pen, knife, spoon, bolt and etc.) that are hard and sharp these objects can also be utilized for dig at that time. The list is provided to conscious agent by framework as output and then agent extracts the most feasible and suitable objects that can dig soil.

The above section proves that proposed framework eliminates the problems investigated in the different agents. Currently available interactive agents do not integrate simple data association with complex level data as in human beings. Considering this restriction dynamic ontological agent integrate low level data to high level of data. Proposed model has the ability to share knowledge in different domains of work. Proposed model analyzes the situation of surrounding environment and then defines and improves its rules and constraints according to situation. It also provide list of alternate solutions for the required problem so that agent will work in environment as humans do.

Knowledge is based on different domain like knowledge association and description. Mostly agent does not extend knowledge and some extends knowledge partially. But proposed model fully observes the environment and extends its knowledge by adding its solutions and rules as learning of agent which can be utilize while making other ontological decisions. Other agents are also base on the previous experiences, but these experiences are static in its nature. But proposed ontological agent has the ability to improve existing previous experience. Assuming that knowledge base of the learning agent extends day by day. Other framework ontology defines only limited solution. If suggested solution cannot be applicable in the current situation, agents are unable to do anything. But the proposed ontological agent has the ability to provide list of possible solution .If one solution is not applicable it provides alternative solution which can be implemented like humans do.

VII. DATA FLOW DIAGRAME



Data flow diagram

VIII. CONCLUSION

This paper defines drawbacks and limitations of the existing ontological agent and proposed new approach that has the ability to define and improve rules and constraints according to the situation, infer new rules and also has the capability to store and utilizes the experiences and has capability to work in hostile environment. Proposed approach not only provides the solution but it provides the list of solutions for the problem so that agent can utilize the best solution according to the current situation as humans do.

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