A Method of Building Ontology Based Information knowledgebase

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Abstract- The knowledge about missile we want to make is represented in ontology. In philosophy, an ontology is "a particular theory about the nature of being or the kinds of existents". It also covers the basic question on how to record the real world. Tom R Gruber discuss a more technical view of ontology, the most prominent definition being "An ontology is an explicit specification of a conceptualization". This definition is often extended by three additional conditions: "Ontology is an explicit, formal specification of a shared conceptualization of a domain of interest". The reference to a domain of interest indicates that for domain ontology one is not interested in modeling the whole world, but rather in modeling just the parts which are relevant to the task at hand. Ontology of missile can be used for proper classification of articles and it helps for information extraction and answering to a search query. Ontology knowledge base for missile is generated using OWL ontology language and it helps to extract information and answering to user queries. This ontology is capable of answering any missile related queries of user interest and it knowledgebase can be enriched by populating new information related to missile. This ontology can help to prioritise multi sensor tracking systems for better tracking coverage and accuracy.

Keywords- Ontology, Missile, Class, Property

I. INTRODUCTION

An ontology is a formal explicit description of concepts in a domain of discourse (classes(sometimes called concepts)), properties of each concept describing various features and attributes of the concept (slots (sometimes called roles or properties)), and restrictions on slots (facets (sometimes called role restrictions)). Ontology together with a set of individual instances of classes constitutes a knowledge base. In reality, there is a fine line where the ontology ends and the knowledge base begins. Classes are the focus of most ontology. Classes describe concepts in the domain.

The development of ontology-based computer systems for various kinds of knowledge work continues apace [1]. Research in the field of Computer Supported Cooperative Work (CSCW) has addressed problems that very much resemble the problems faced by those engaged in the building of ontology. Till now there is no ontology available related to missile system. This motivates us to build missile ontology.

One defence related topic (missile) is chosen to build up ontology knowledgebase using web ontology language [4][5] (OWL). Protg frame work [6] is used to build up the ontology. Missile related ontology does not exists currently. Our missile ontology will add a new ontology knowledge base in the defence field. All information presented in this paper is collected from internet which is freely available.

Section II presents the missile ontology properties such as object property and data property.

Section III deals with the missile ontology classes. Missile ontology classes are catagorised as guidance class, propellant class, warhead class, range class, categories of missile class and country of origin class.

In section IV example of prithvi missile class is explained and at the end section V is about conclusion and related work.

II. MISSILE ONTOLOGY PROPERTIES

Missile Object Property
Properties are binary relations on individuals. Properties link two individuals together. Property is of two types namely object property and data property. Object property defines the range and domain class of the relation.

Here object property hasComponent has sub object properties like hasGuidance, hasPropellant and hasWarhead, hasGuidance links between Missile and Missile Guidance classes. Similarly hasPropellant links between Missile and Missile Propellant classes and hasWarhead links between Missile and Missile Warhead classes. The inverse object properties isGuidanceOf, isPropellantOf and isWarheadOf are also defined for all
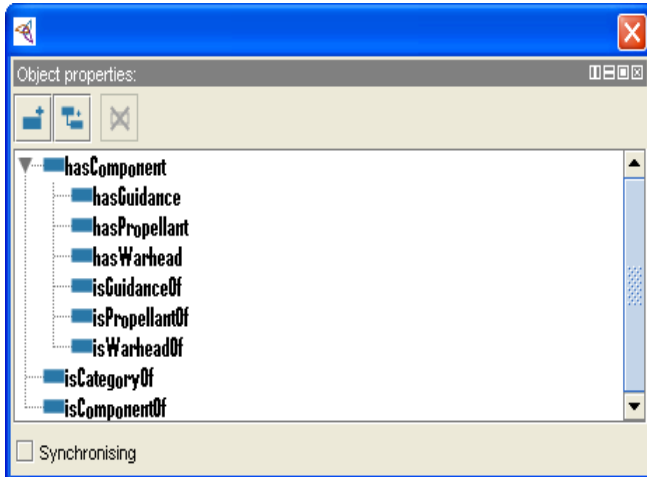
Fig.1 A view of Object properties of Missile Ontology

these three object properties respectively. All these properties are functional. Functional means properties can be limited to having single value. They can also be either transitive or symmetric. Two more object properties are defined like isCategoryOf and isComponentOf. isCategoryOf links between missile and Categories of Missile. isComponent is inverse property of hasComponent.
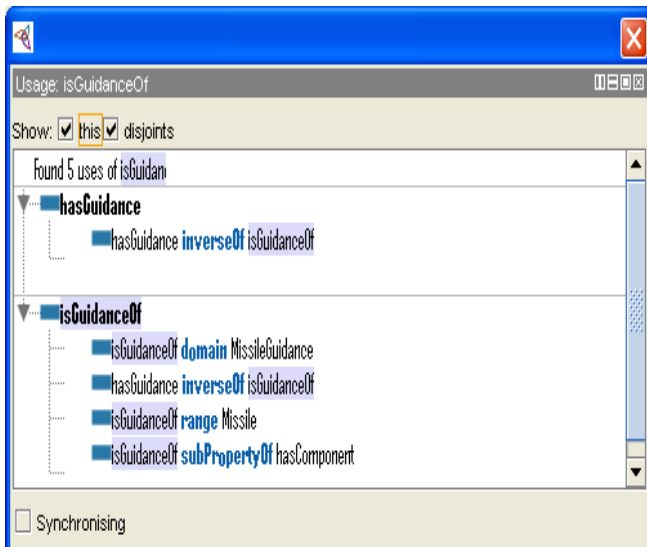

Figure 2 A view of Usage of is Guidance of properties of Missile Ontology

Missile Data Property

Data property is used to define the data values for any classes. In this missile ontology two data properties are defined, one is hasRange and another hasPayload. Both these data properties are of integer type and functional relations. There are some data restriction is also implemented to define the range of allowable value precisely. Cardinality restriction deals with the maximum allowable relations with a class.
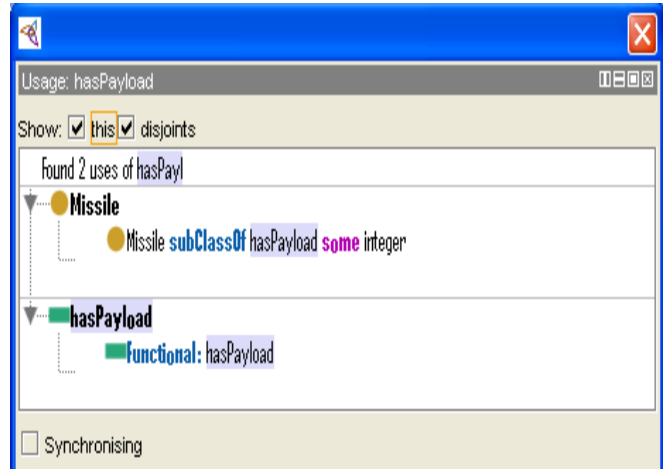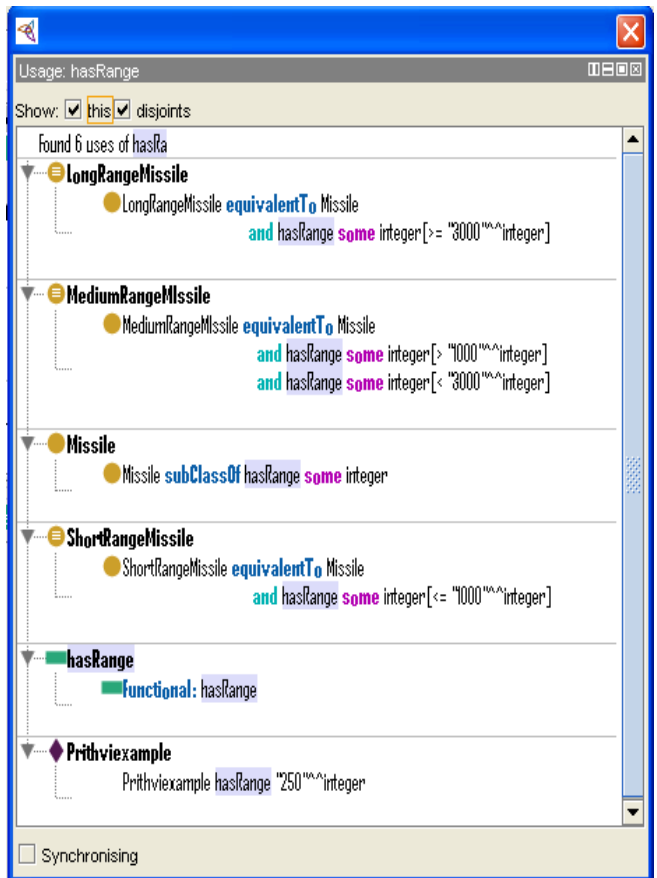

Figure 3 Property description for has Payload

Figure 4 Property description for has Range

III. MISSILE ONTOLOGY CLASSES

OWL classes are interpreted as sets that contain individuals. They are described using formal (mathematical) descriptions that state precisely the requirements for membership of the class. In our missile ontology main class is named as Missile.

Missile Guidance Class

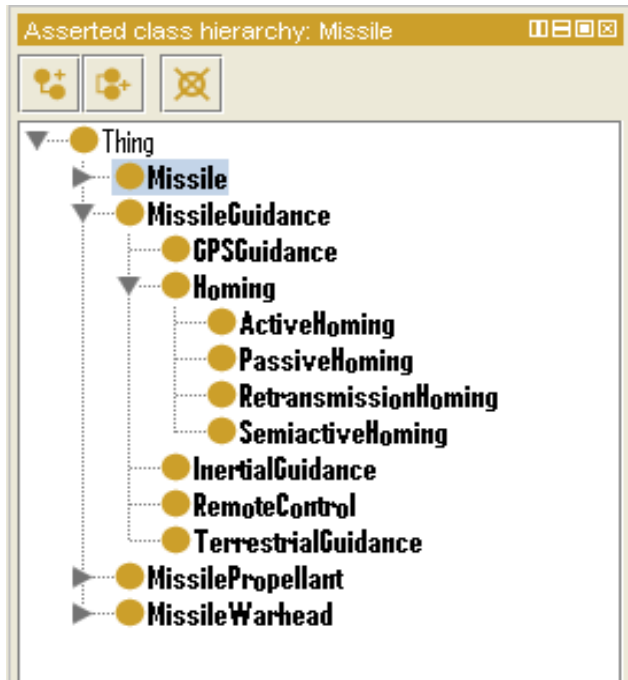Missile Guidance class is used to describe the types of

Figure 5 View of Missile Guidance class

guidance and it has five sub classes like GPS Guidance, Homing, Inertial Guidance, Remote Control, and Terrestrial Guidance. Homing is further classified as Active Homing, Passive Homing, Retransmission Homing and Semi active Homing.

Missile Propellant Class

We have defined Missile Propellant classes. It is used for describing propulsion systems used in missile. It has two subclasses namely Solid Propellant and Liquid Propellant.
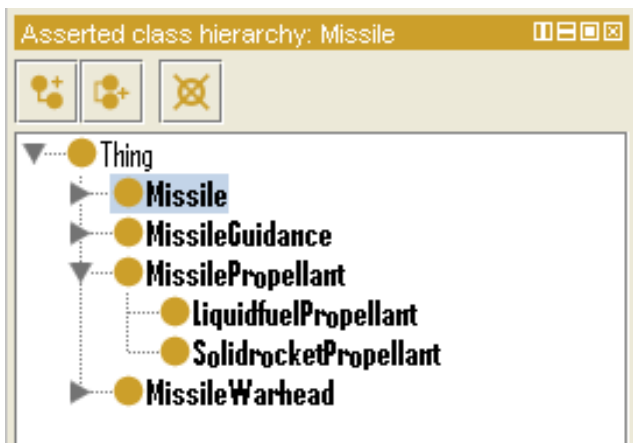

Figure 6 View of Missile Propellant class

Missile Warhead Class

Missile Warhead class is another class defined for warheads used in missile, it has three subclasses. Normally missile warheads are of three types one is conventional second is nuclear and third is chemical and biological. Here three subclass of the Missile Warhead class has three subclass and these are defined as Chemical-biological Warhead, Conventional Warhead and Nuclear Warhead. Three classes MissileGuidance, MissilePropellant and MissileWarhead are defined as the disjoint class.
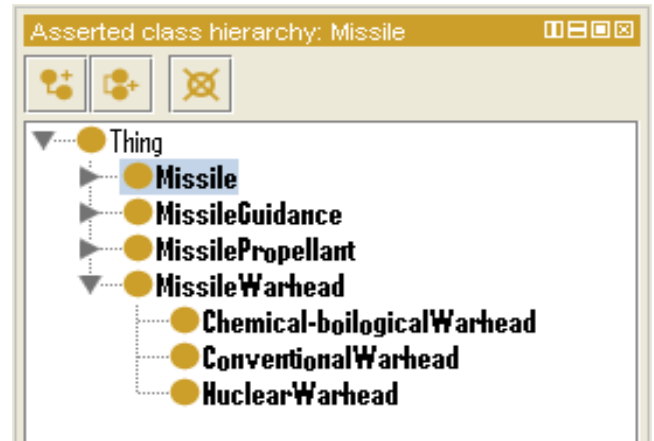

Fig.7 View of Missile Warhead class

These classes are the parts of the missile and these are related with the missile class with the property relation hasComponent and isComponentOf.

Missile Range Class

Ranges of the missiles are defined using separate classes. Range classes are equivalent class of Missile class. It means that both the classes having same properties and all range classes are disjoint classes. Range of the missile generally termed as long medium and short so in our missile ontology. We have defined three classes to describe the missile ranges these are Long Range Missile, Medium Range Missile and Short Range Missile. These three range classes are disjoint classes. All range classes are equivalent class of missile class and has an integer range value. For long range missile the range value is set to greater or equal to 3000 km, medium range is defined for the missile of range more than 1000 km and less than 3000 km. Short range missiles are those which have range less or equal to 1000 km.

Missile range classes have the property of hasPayload of integer type. Class description of the missile range classes are defined in similar manner. Description for the long range missile class is given below.
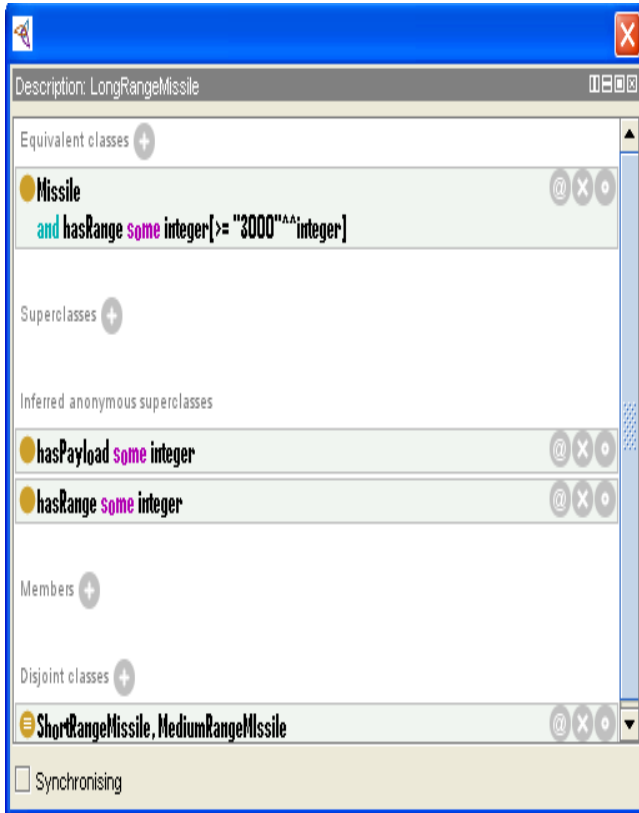
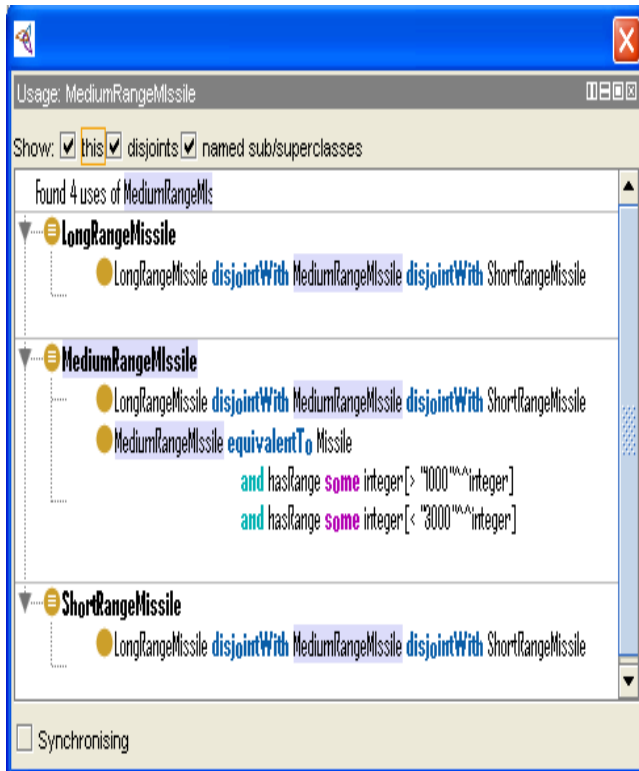Fig.8 Class description of Long Range Missile class

Fig.9 Usage view of Medium Range Missile class

Categories of Missile Class

There are classes to define categories of missile. In our missile ontology we have defined a class named Categories of Missile and under this class ten numbers of subclasses are defined for different categories of the missile.
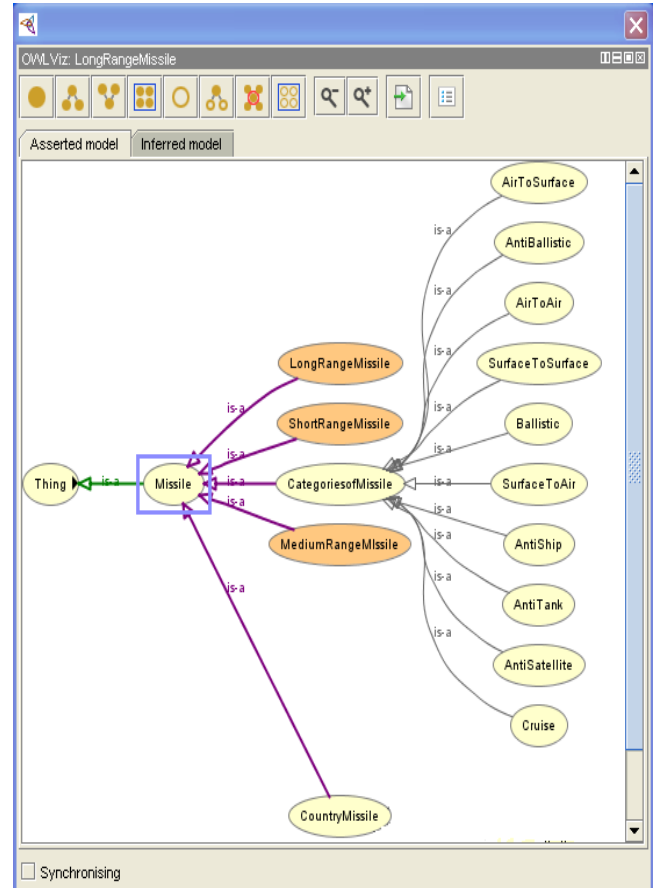

Fig.10 A view of subclasses of Categories of Missile class

All these ten sub classes have has Payload property of some integer value and has Range property of some integer value. Air to Air, Air to Surface, Surface to Air and Surface to Surface are disjoint classes under Categories of Missile class. Categories of Missile class has sub classes named Antiballistic, Antis hip, Anti-Satellite and Antitank. These are defined as disjoint classes. Two more classes are defined as subclasses of Categories of Missile class. Ballistic and Cruise classes are subclass of CategoriesofMissile and these are defined as disjoint class.

Country Missile Class

Country Missile class is the super class of the different country classes. In our missile ontology Country Missile class has a number of subclasses as Indian Missile, Pakistani Missile and US Missile etc. Each and every sub classes of CountryMissile class is used to describe the missiles of that country.

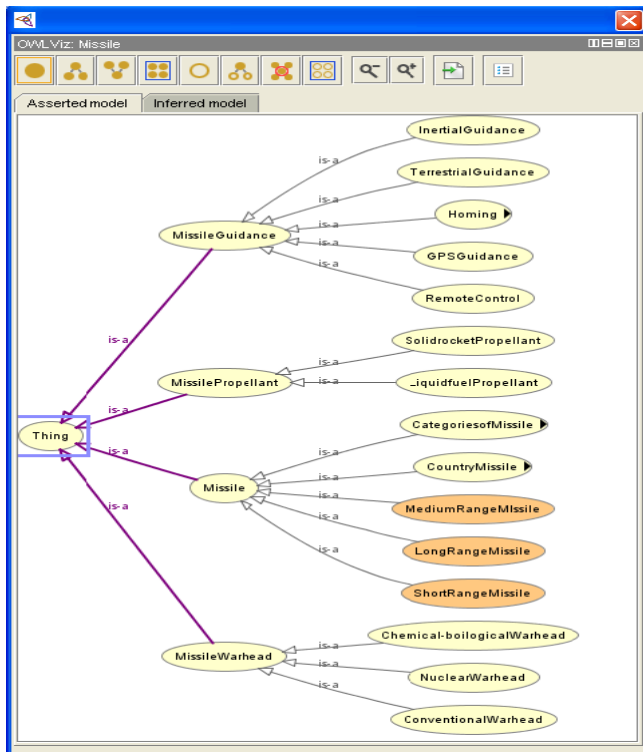Fig.11 Class hierarchy view of the Missile ontology

Fig.11 A typical class view of the Missile Ontology

IV. CASE STUDY (PRITHVI CLASS AS EXAMPLE)

In this case study as well as in this whole paper, information freely available in internet related to Prithvi missile is used. The values, properties etc. may or may not be correct. However this case study will serve the purpose to elaborate specific missile ontology relevant class, super class, disjoint classes, sub classes etc. discussed in previous sections.

Prithvi is an Indian missile. To describe the prithvi missile all the class, super class, subclass equivalent class and disjoint classes related to prithvi class has to be defined. Object Property and data property of the prithvi class is also to be defined.

In our Prithvi missile class description it is placed under the Country Missile class. Super class of the prithvi missile class is IndianMissile class. Prithvi class has object property of hasGuidance and its guidance is of some type of Inertial Guidance. It is Category of object property and it is of some Ballistic and Surface to Surface missile has Propellant object property is related as only relationship with Liquid Propellant. Conventional Warhead is related to Prithvi by hasWarhead object property. Prithvi class is defined with hasPayload and has Range data property of data type integer. Prithvi class is defined as disjoint class of other sub classes of Indian Missile class. In this similar manner each and every missiles are defined.
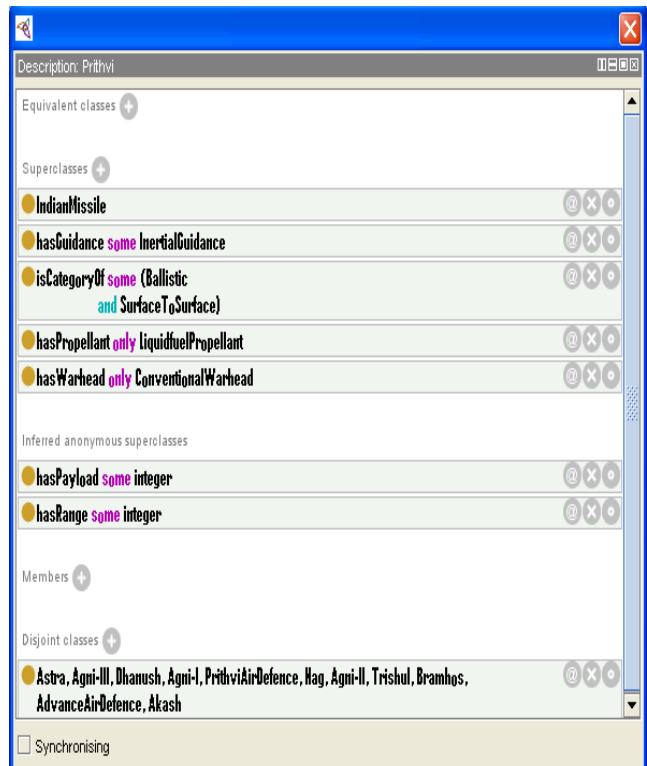

Fig.12 Class description for Prithvi

V.CONCLUSIONS

Ontology of missile is build up and it is the knowledge base of missile systems. Currently Missile ontology is not available anywhere. We have developed missile ontology and it consists of basic missile parameters of all missiles currently available throughout the globe. The missile ontology will become richer with the information extracted by the information extraction system. Further we can improve the missile ontology by adding some more parameters of missiles. Information extraction system will extract missile related important information and those are being populated into the missile ontology knowledge base. Once the ontology knowledge base is build up it could be used to get information related to missiles. It could be used to categories different missile. Range, propellant and trajectory knowledge base could be used to identify most suitable trajectory tracking sensors and further it could also be used to prioritize the trajectory tracking sensors.

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