Cognitive System for Knowledge Representation of Elementary Pragmatics

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Abstract. The focus of this article is to throw light on the imminent need for an effective system for extraction, representation and construction of legal norms, especially the national patent law norms. This system, complementary to the FSTP-Expert system, would aim at (semi)-automatically translating the parts of the notion "legal certainty" from its natural language non procedural presentation to a declarative logical presentation by formal modeling through interpreting the pragmatics facts based within a National Legal Systems. This paper covers the initial abstract solutions and possible outcomes as gathered during the first year of PhD research.

Keywords. Facts Screening and Transformation Processor (FSTP), Innovation Test, Innovation Expert System (IES)

1 Motivation

The need of a sub-system for automating the application of elementary pragmatics[1], 'EP' and National Patent Laws into the existing Facts Screening and Transformation Processor, 'FSTP'[1]/Innovation Expert System, 'IES'. This enables a person of pertinent skill, who is needed for recognizing non-elementary pragmatics, to recognize automatically and/or guided interactively by the FSTP ES to consider whether the properties an innovation at issue can be considered as Anticipate (A), Not-Anticipate (N) /Contradicts (C) to its prior arts/ considered reference set (RS).

2 Background - The Fact Screening and Transformation

As described in [1], "an innovation/creation over existing knowledge, provided as a reference set RS of prior art documents, is representable by a technique teaching TT.p which goes beyond the knowledge of the RS – just as in a patent/application.

[1] Elementary pragmatics are disclosures (explicit/implicit) of certain art which can be easily understood by a person of pertinent skill

This compound of knowledge, representing an innovation, is called “PTR”, standing for a “pair of TT.p and RS”.

The Innovation Expert System (IES) thus is the PTR Expert System, defined by the epistemological and practical requirements it meets: For any PTR to which it is applied, it is supporting its user in

1. deriving from a PTR all technical facts for determining the “creativity geometrical” height of TT.p over RS, and
2. Instantly recognizing and replying to any rational query as to any relation between this TT.p and this prior art RS.

The PTR Expert System (ES) is built around the PTR’s “FSTP Test” (FSTP =“facts screening & transforming processor”), and hence is also called FSTP ES. The FSTP Test of a PTR supports initially screening its documents for all technical informal fundamental facts, then transforming them into technical formal fundamental facts, then transforming those into the technical primary facts, and finally transforming them into the technical secondary facts, called **basic** resp. **semantic** (alias **creative**) resp. **pragmatic** (alias **innovative**) facts. These technical secondary facts use metrics induced by the Highest Courts precedents’ on creativity/innovation – by their numbers of RS-orthogonal and independent thoughts embodied by TT.p. From the basic facts the classical yes/no answer to the question, whether TT.p is indicated **obvious** over RS, can be derived by this metric. The semantic/creative and pragmatic/innovative facts extend this metric much further by first defining a PTR plcs specific (plcs = patent law carrying semantic) innovation geometry, which depicts the plcs-height/-**creativity** of its TT.p over its RS. Based on plcs-height/-creativity, TT.p’s pragmatic/innovative height over RS additionally takes into account the PTR’s “patent monopoly granting pragmatics”. A pmgp, in any National Patent System (NPS) which represents the national/socio/economic principles underlying the idea of rewarding an innovation by granting a 20 years monopoly to its TT.p. Hence a subsystem capable of (semi-)automatically translating the parts of the notion “legal certainty” from its natural language non procedural presentation to a declarative logical presentation by formal modeling through interpreting pmgp based on NLS/ (NNI = National Normative judicial Interpretation of facts).

Figure 1, shows different Knowledge Representation (KR) domains with subdomains which cause an impact on a PTR during FSTP Test. The object of our concern in this thesis is to create KR domain dealing with NPS, and having EU PS, US PS, AU PS etc. as sub-domains. The formal modeling involves modeling of NLS/NNI by ontologies and rules using deductive (non-monotonic) reasoning for legal interpretations and inductive logics for learning.

3 Goals/Aim

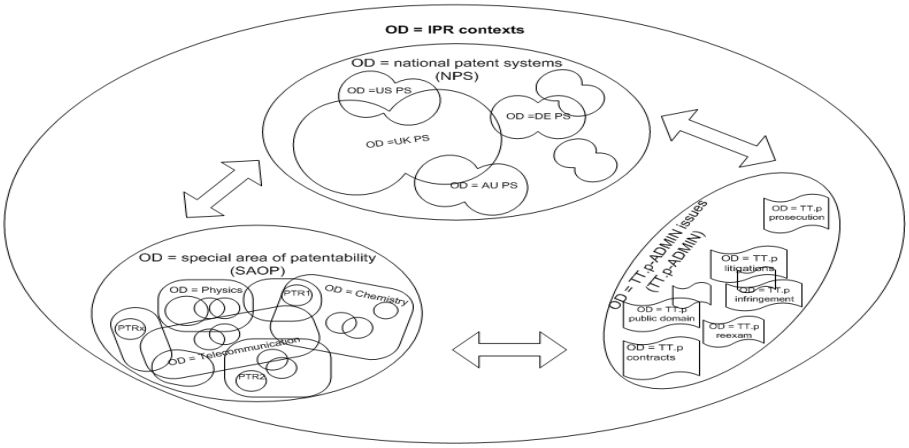
1. To analyze and extract the rules and ontological concepts described in the natural language descriptions of NPSs.

2. To identify the required semantics and inference rules needed for legal reasoning with NPSs and for the legal interpretation enabling the separationg of novel innovations from obvious steps.
3. Logic-based declarative representation of these chains of complex rules for legal reasoning on top of structured formal ontologies domains representing the conceptualization of the NPSs and the underlying domains of skill and elementary pragmatics.
4. Developing a legal reasoning sub-system to the FSTP ES which allows pmgp dependent information to be derived from the NPS knowledge bases and to be used in the FSTP for semi-automated legal decision support and compliance checks with the applicable NPS for a PTR. This includes:
   (a) Address the trade-off between required expressiveness of the knowledge representation and its computational complexity of the legal reasoning in the FSTP
   (b) Provide support for the different roles involved, such as inventor, person of pertinent skill, examiner, patent agent etc. This requires different representation languages from natural-language format for expressing questions, answers, proofs and explanations to platform-independent serializations in XML and Semantic Web formats, to platform-specific executable formats on the logical reasoning layer
   (c) Provide support for life cycle management of the knowledge. This addresses e.g., collaborative knowledge engineering and management (versioning, different roles such as author, maintenance), updates in the NPSs by new decisions which lead to corresponding isomorphic updates in the NPSs knowledge bases, integration of internal and external (semantic) background knowledge e.g. about skill, elementary pragmatics, usage data (annotations, proofs, etc.)

4 Research Questions

The research question will be refined and detailed after the literature review and baseline study, from the following general problem domains of a knowledge representation

1. **Syntax:**
   (a) Which representation and interchange format for the representation of the knowledge on different representation layers? (human-oriented computational independent, platform-independent supporting integration and interchange, platform-specific logical reasoning)
2. **Semantics:**
   (a) Which inference and interpretation semantics (non-monotonic vs. monotonic, expressiveness vs. computational complexity, closed-world vs. open world, "ontologies vs./and rules", …)
3. **Association problem:**
   (a) How to connect the formal representation with the real-world resources and norms?



1. Fig. 1**. Interdepence of domain ontologies (Source: [1])**

Requirements derived from these knowledge representation problem domains can be distinguished according to functional requirements for the concrete knowledge representation and non-functional requirements during design time (development / engineering of the knowledge) and run time (use of the knowledge).

- Functional Requirements
  - e.g., expressiveness, …
- Non functional requirements at design time
  - e.g., composability and extensibility, interoperability, declarative implementability, modifiability and evolvability, reusability and interchangeability, …
- Non functional properties at runtime
  - e.g., usability, understandability and explanation, correctness and quality, scalability and efficiency, safety and information hiding (need-to-know principle), …

5 Proposed Approach

An abstract model of the system envisioned as a solution to the problem can be seen in Figure 2. An existing state-of-the-art prior art search module, using a semantic search engines like, Cognition [2], DeepDyve, etc… retrieves patents through large databases which forms the required RS (if previously not specified by the jury) for the TT.p. Thus formed PTR will be transformed from their natural language texts into some standard representation formats like XML, using text-mining and semantic recognition and annotation techniques supporting human knowledge engineers in the fact screening and transformation process.

Similar to the PTR, the existing patent rules from NPS have to be transformed from their natural language format to more standardized rule representation formats

like Reaction-RuleML [3], LKIF [4], or the upcoming Legal RuleML etc… thereby, providing a powerful and declarative way to control and reuse such semantically linked meanings with the help of independent micro-ontologies about the NPSs and domain specific pragmatic contexts (skill ontologies, elementary pragmatics, standards etc.) for a flexible processing and legal reasoning [5]. The required (patent) rules/constraints are built by the rule creator module, which uses a rule-based agent networks like Prova [6] for realizing distributed rule inference services.

Such built rules may be;

1. Simple: Built based simple on Patentable Subject Matter (PSM) constraints, which are readily available out of any NPS. Like,

/* Invention dealing with plant, animals or seeds are not permitted to be patented */
or
/* Process of learning language, playing chess, teaching or operating machinery are not patentable */

```
PSMCriteria1 ≡ (Invention Λ (Product v Process) Λ (¬
                    Plant v ¬  Seed v ¬ Animal))
PSMCriteria2 ≡ (Process Λ (¬ LearningLanguage v ¬
                    PlayingChess v ¬ OperatingMachinery
                    v ¬Teaching))
```

2. Complex : Built based on deductive logic [8] to match the elementary patent rules with background facts then using inductive logic in generalizing goal facts into rules that connect with background facts.

/* use of any radioactive substance or any process for atomic energy production, control or disposal cannot be patented */

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PSMCriteria3 ≡ ∀ Invention ∃ SubjectMatter (Process Λ (¬
          AtomicEnergy Λ (¬Production V ¬ Disposal V ¬
          Control)) Λ (∃ Element (¬RadioactiveSubstance)).
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3. Compound: Built based on combination of several rules (deductive rule chaining).

/*for prior-claiming, the invention claiming priority should have been patented in US, the inventions priority-claim-date should be before the newly claimed invention and publishing date should have been before the newly claimed invention*/

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Criteria4 ≡ Invention Λ (Product v Process) Λ (Country
             (US)))

Criteria5 ≡ InventionPriorityDate (ClaimingInvention <
             ClaimedInvention)
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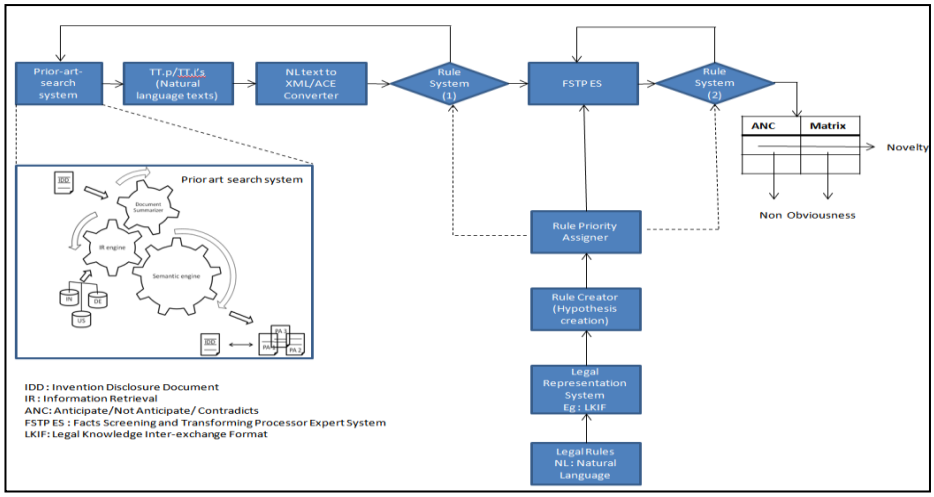

Fig. 2. System model overview

$$Criteria6 \equiv InventionPublishDate\ (ClaimingInvention < ClaimedInvention)$$

$$PriorclaimCriteria7 \equiv Criteria4 \wedge Criteria5 \wedge Criteria6$$

Such built rules are assigned priorities using, e.g.defeasible logic and scoped reasoning for distributed modularization of the knowledge bases (such as used in the Rule Based Service Level Agreement project and supported by Reaction RuleML (and the new upcoming Legal RuleML).

Standardized rules with priorities enable arguments to be created, evaluated and compared. One such category of rules are Elementary Pragmatic (EP) rules, which including legal rules that can be applied at different fact gathering stages of the FSTP expert system on a PTR. Few examples for such discretization stages and their applicable elementary rules are as shown in Table 1.

Elaborating more on the concept identification stage, validation of identified concept/concepts is a process of filtering the concepts identified from a patent document, TT.0 based on existing EP's. Thereby, segregating them into non-patent-eligible, 'npe' and patent-eligible, 'pe' concepts. A concept under 'pe' may also be known as creative concepts, Cr-C. Certain complex concepts need a combination of EP's to be applied together to classify them as 'npe' which would otherwise have been considered as 'pe' concept.

5.1 Proposed Framework

We propose a legal information system framework as shown in Figure 3. The proposed framework is built based on a general information system research framework [7]. The central Research module is fed with information from both Environment and Knowledge Base (KB) modules. Information/ raw material such as FSTP facts, which include the norms from various NPS's, are fed by the Environment module and the syntax, semantics, pragmatics and instantiations encompassing a norm are fed by the Knowledge Base (KB) module. The central research module works towards building the inference rules required for the legal reasoner. The develop/Build sub-module including legal reasoner is evaluated for the norm's expressiveness, extensibility and interoperability criteria's. Based on the results, the rules and the reasoner are refined again. This iterative process of (re-)assessing and refining is completed when all criteria's are effectively evaluated. Processed information is fed back to the environment module for its actual usage within the FSTP ES. Additional information for the lifecycle management of a norm and its contexts are is sent back to KB module.

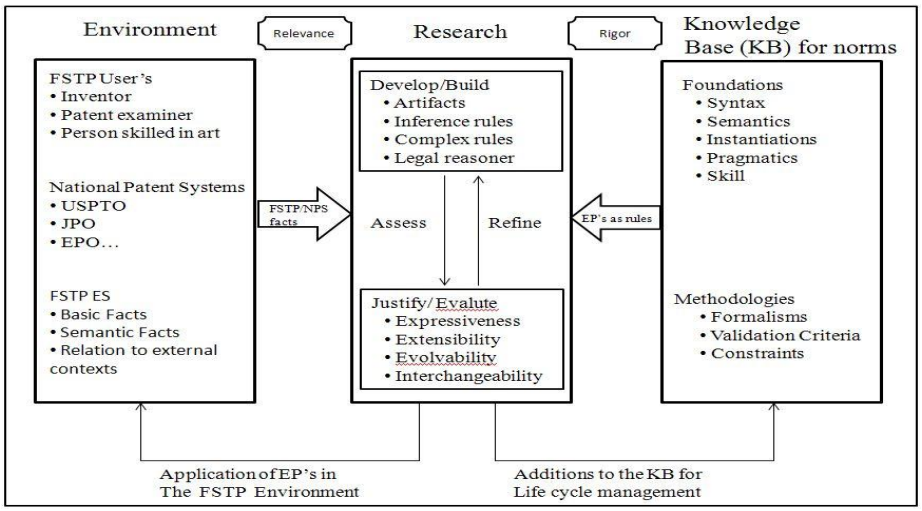

Fig. 3. Legal (esp. Patent) Information system framework.

5.2 Elementary Pragmatics

Elementary Pragmatics are disclosures (explicit / implicit) of certain art which can be easily understood by a person of pertinent skill. According to certain National Patent Systems, an EP must not be just claimed to exist, but must be documented in an enabling way.

FSTP discretization stages	Elementary rules applicable	Explanation
Element identification stage	PSMCriteria1	Elements with Plant or Animals or Seeds not permitted
Attribute identification stage	PSMCriteria2	Attributes having below methods are not permitted a. Method of learning language b. Method of teaching c. Method of operating machine
Concept identification stage	PSMCriteria3	Concepts with below references are not permitted a. Musical notations b. Coloring substance for identification c. Atomic energy i. Production ii. Control iii. Disposal d. Radioactive substance

Table 1. FSTP discretization stages and their applicable elementary rule

EP can be divided into 4 types, table 2 shows few trivial example concepts considered as 'npe' for each EP mentioned above:

- EP from Natural Laws of Nature, EP-NL
- EP from Natural Phenomenon's, EP-NP
- EP from National Legal(Patent) Systems, EP-NPS
- EP from Skill Documents/Standards, EP-STD

EP	Concepts related to
EP-NL	Speed of light Theory of relativity $E= mc^2$ Dijkstra Algorithm
EP-NP	Gravity Human metabolism
EP-NPS	Method of learning Language Method of teaching Production/Control/Disposal of atomic energy
EP-STD	Maximum delay for data transfer in ordinary telephone is 0.5 secs ISDN line has a stack of three protocols

Table 2. Shows few trivial example concepts considered as 'npe' for each EP mentioned above

5.3 Examples : Landmark cases

Mayo vs Prometheus.

Invention summary: Administration and use to thiopurine drugs to treat auto-immune disease

Concepts:

C1: Physician administers the drug given to the patient using 'administering step'

C2: Physician measures the resulting metabolic levels in the patient's blood

C3: Physician compares the patients metabolic level against known safe and effect tive metabolic levels and then decided to increase or decrease the drug dosage.

$$\text{Criteria8} \equiv (\text{Process} \vee \text{Manufacture} \vee \text{machine} \vee \text{composition of matter})$$

$$\text{Criteria9} \equiv \text{Criteria8} \wedge (\neg \text{EP-NL} \vee \neg \text{EP-NP} \vee \neg \text{EP-STD} \vee \neg \text{AbstractIdea})$$

{EP-NPS}	{C1}	'**npe**'
{EP-STD}	{C2}	
{EP-NL}	{C3}	

Even though all concepts defined above seems to qualify all criteria's at the first glance, On addition of pragmatic context (using micro-ontologies) to our analysis, Concepts, C2 and C3 identified in the above example fail to qualify the 'criteria 9', while concept C1 qualifies the 'PSMCriteria1', 'Criteria 8' and 'criteria 9', it fails to qualify 'PSMCriteria2'. Thus, grouping all identified concepts as 'npe'.

Newman vs United States Patent Office.

Invention summary: A device which will produce mechanical power exceeding the electrical power being supplied to it.

Concepts:

C1: Electromagnetic energy can be rendered by a rotating permanent magnet spinning inside an electromagnetic pulsating conducting coil.

C2: Rotating permanent magnet spinning inside an electromagnetic pulsating coil utilizes the coil mass energy and turns in into torque.

{EP-NL, EP-STD}	{C1}	'npe'
{EP-STD}	{C2}	
{EP-NPS}	{C1, C2}	

Concepts C1 and C2 do not pass the ‘criteria 9’ while a concept formed by combining concept C1 and C2 would also fail to qualify the PSMCriteria1. Thus making the entire invention as ‘npe’.

6 Conclusion

The solution to have a sub-system, based on configurable EP which connects the FSTP ES, thus making it full/-semi automatized in handling queries pertaining to EP and NLS thereby, providing a uniform platform for standardizing the generation and representation of complex rules (built using fewer NPS goal clauses/(patent) rules. Such a system would serve as a ready reckoner in drawing legal conclusions on top of scientific fact determined during FSTP analysis. This would then help in applying the (elementary) cognitive norms required for interpretation and evaluation of such identified facts.

7 Acknowledgements

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