

RESEARCH ON SMART MATCHING OF TECHNOLOGY DEMAND AND SUPPLY IN MANUFACTURING INDUSTRY

YAO LIU AND YI HUANG

Institute of Scientific and Technical Information of China
No. 15, Fuxing Road, Beijing 100038, P. R. China
liuy@istic.ac.cn

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ABSTRACT. *In response to “mass innovation, mass entrepreneurship” policy, to enhance the utility of the search engine service in the manufacturing industry, based on the innovation service model and idea, we develop intelligent matching service to effectively address the problems existing in technology supply and demand chain in the innovation process, connecting technology demands with technology providers, so as to maximize the interests of all stakeholders involved. The application in the open innovation platform shows that smart matching technology can effectively make a match between technical need and technology provider, and further promote the cooperation so as to improve the overall innovation environment in the manufacturing industry in China.*

Keywords: Natural language processing, Smart matching, Search engine, Mass innovation

1. **Introduction.** Manufacturing level is closely related to the country’s economic life-line. Small and medium-sized manufacturing enterprises (SMEs) are an important part of our national economy, and have played an important role in increasing economic prosperity and easing employment pressure. However, with the increase in labor costs, SMEs are facing the issues such as lack of resources, and low manufacturing utilization. In addition, SMEs may have some good new design ideas or programs, but lack of resources, systems or other relevant resources makes them not able to put the design into production, which ultimately seriously affects their long-term development [1]. Meanwhile, with the continuous expansion of SMEs’ business, the needs to get data management, design, production and testing process also increase dramatically. The traditional manufacturing resource management services struggled to meet such a drastic increase in the matching, allocating and trading of service resources under the innovation policy. Therefore, it is necessary to work out an engine that matches supply and demand to facilitate SMEs facing such huge amount of information, rational management of manufacturing resources, as well as improving the efficiency of the service resources trading collaboration between SMEs, so as to optimize the manufacturing services. Currently, most studies focused on matching method based on semantic web, although the method can effectively make a match, but it is difficult to achieve in the actual application process [2]. In view of this, this paper focuses on intelligent matching engine for supply and demand in manufacturing industry, through the construction of manufacturing ontology combined with deep semantic annotation technology, to organize technologies and resources according to users’ needs, and further improve the service efficiency in resources exchange and collaboration between SEMs. The rest of this paper is organized as follows. Section 2 introduces idea and framework. Sections 3 describes the methods and key technologies. Application and demonstration are shown in Section 4. Finally, a brief conclusion and future work are given in Section 5.

2. Idea and Framework. For a technical demand side, he needs to easily publish technology request and find the necessary technology; for a technology supply side, he needs to find the right request to promote business cooperation. In view of this, we propose a smart matching algorithm providing users with precise matching and recommendation: first, to get enough raw materials from the Internet; second, to parse and analyze and extract useful information from these materials, and reconstruct the data; and third, to use these data to provide application and services [3]. The whole process is shown as follows:

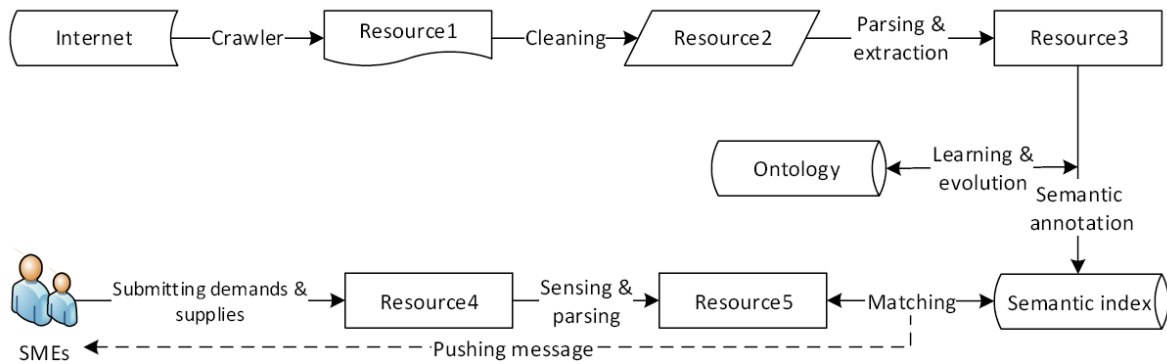


FIGURE 1. Design idea and framework

3. Methods. With the design idea and framework, this paper conducts key technologies research in intelligent semantic crawler, domain ontology construction and semantic annotation and indexing.

3.1. Data collection with intelligent semantic crawler. Intelligent semantic crawler is developed to retrieve data from the Internet, including patent, paper, industry and news data. It makes good use of the structure and content of a domain ontology or subject headings: to download relevant data of a concept with all its attributes by adding links from search engines like Google, Yahoo and Baidu to URL list, calculate how closely a link or a webpage is related to the concept based on the anchor text as well as its



FIGURE 2. User interface of intelligent semantic crawler

content, and put them into download queue if it is greater than a certain threshold value according to relevance score. At the same time, all the data is parsed and analyzed to extract certain useful information based on customized templates, such as the name of a technology holder, contact information and research fields of interest [4,5].

3.2. Domain ontology construction. By fully using the previous research results, domain ontology is being constructed with web ontology construction platform, regarding the support services and resource characteristics of mass entrepreneurship and innovation activities. Technology, product and enterprise are chosen as the top-level concept categories of the domain body. Enterprises are categorized into medium and small enterprises by size, and products are categorized into patents, prototypes, and products according to the product lifecycle. In this way, we can get a steady stream of ontology-based enterprise data, combined with technical information, and auto-discovery of new enterprises. Gradually, a business information database with information repository technology is built, and it also provides further support for the knowledge discovery. It helps to quickly build domain ontology by utilization of existing knowledge data. The core goal is to build domain knowledge, and establish field vocabulary as the basis for knowledge-based text information discovery to extract business and technical information to construct a dynamic, inner-connected and dimensional knowledge structure [6,7].

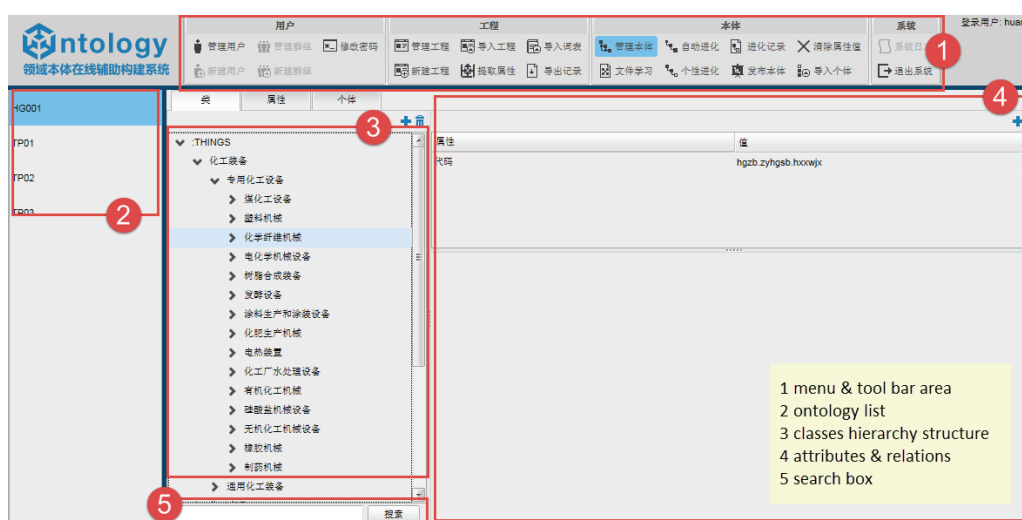


FIGURE 3. Web ontology construction platform

3.3. Semantic annotation and indexing. Using natural language processing techniques and machine learning methods, we make full use of concepts, attributes and relations among concepts of domain ontology to conduct semantic annotation and achieve synchronic implementation of semantic annotation and resource organization semantic process on the data collected from the Internet. Semantic indexing is not like full-text index that regards the entire document as one part of index, but divides the document into different particle sizes (paragraph level, sentence level) in the annotation process through a unique linguistic processing (like adding synonyms, stop list, ambiguity correction, entity extraction, etc.) to re-construct the unstructured data into structured data so as to provide users with a highly accurate technology demand and supply matching services [8,9].

4. Application. This study conducts application demonstration in electric appliances manufacturing field in the open innovation platform. With intelligent semantic crawler, we collect about 2 million articles or news, 2500 technical solutions, 5 million patent document as the corpus for processing. And all these data are being cleaned and processed

in a normal natural language processing way, saved in xml format files. Then a domain ontology containing about 20 thousand concepts related to manufacturing industry is constructed. Based on the domain ontology, all the xml files are conducted semantic annotation process to connect technology name, technical characteristics and other information with concepts in the domain ontology to build an inner-connected and dynamic knowledge structure. The application results are shown as Figure 4, Figure 5 and Figure 6. The homepage of the open innovation is shown as Figure 4. The smart matching search engine with multi-function is shown as Figure 5. And technical solution automatic generating result is shown as Figure 6.

With smart matching engine integrated in the platform, it shortens product development and marketing cycles. SMEs can make good use of intelligent analysis and matching results with matching resources, information and technologies recommended for them. And for the technical and resources provider side, some creative suggestions and reviews



FIGURE 4. Home page of open innovation platform



FIGURE 5. Smart matching engine search results

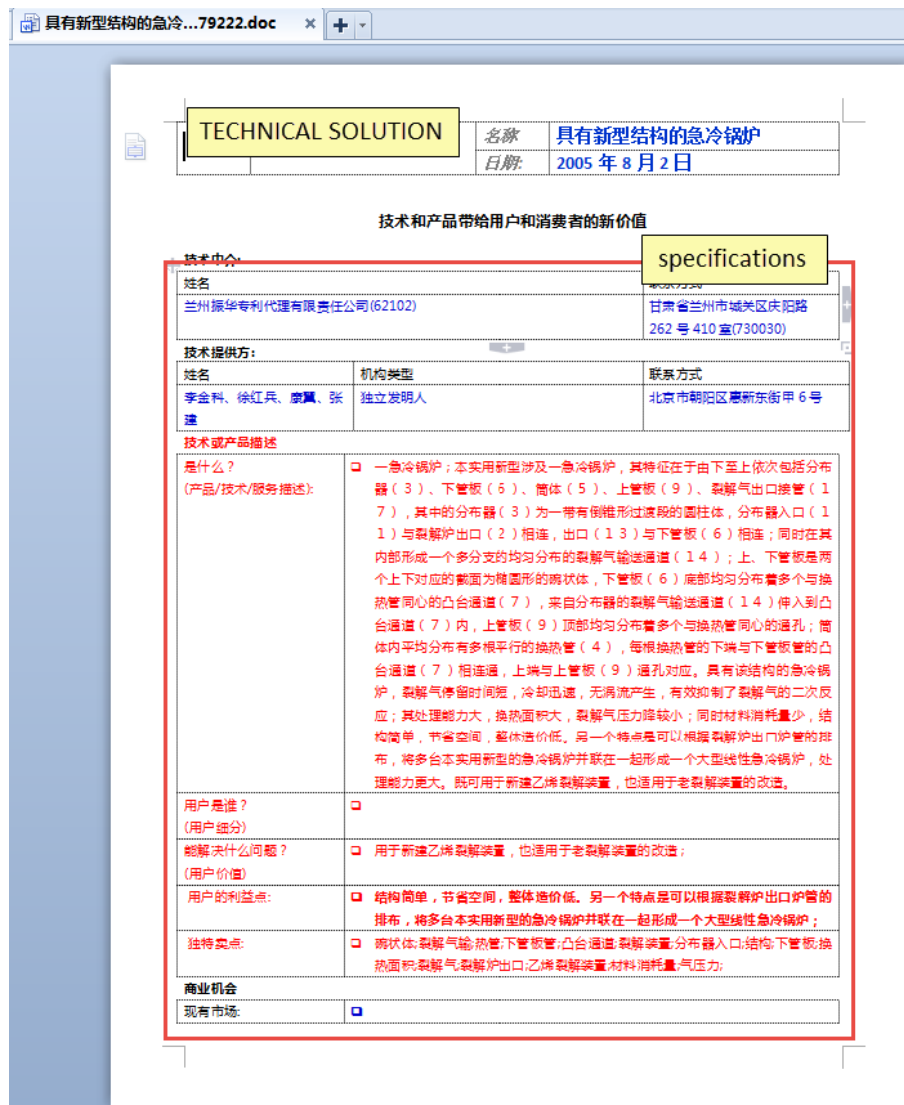


FIGURE 6. Technical solution generating & exporting

can help the developer to collect more practical, market-oriented direction information to further spread influence of the products among a much larger audience. In addition, it also brings market analysis, financing hatch, hardware development, software development, large data, industrial design, production and supply, sales channels, and all other aspects of resources with effective integration into open innovation platform to promote SMEs conducting innovation activities so as to build an open and innovative atmosphere and environment in China.

5. Conclusions. Based on the innovation service model and idea, this paper conducts key technologies research and develops intelligent matching engine to effectively address the issues existing in supply and demand chain in the innovation process, connecting technology demand with supply for SMEs so as to maximize the interests of all stakeholders involved. The application in the open innovation platform shows that smart matching technology can effectively make a match between technical need and technology provider, and further promote the cooperation so as to improve the overall innovation environment in the manufacturing industry in China. In the future, we intend to proceed along two lines in parallel: on one hand, to conduct research on technology and enterprise innovation evaluation to further enhance the matching ability; on the other hand, to broader its application fields other than manufacturing industry.

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