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Creating patents on the new technology using analogy-based patent mining

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ABSTRACT

Patents on the new technology–a technology not yet commercialized and in an early stage of its life cycle–give firms many benefits. However, existing methods are inadequate because of dependencies on customers and physical prototypes. And there is lack of systems, focused on a problem identification process or an inter-technological comparison. In this research, to remedy existing limitations, analogy-based patent mining system is suggested. The system is developed based on an assumption that similar problems would occur in technologies that have similar properties or functions. So, the system is focused on identification of a Problem Solved Concept (PSC), which describes what problem is solved in the patent. At the first part of the system, the mature technology–a technology relatively matured than the new technology–is described with a property and a function; one of the property or the function should be similar to which of the new technology considered. And the system extract PSCs, construct patent map, and evaluate PSCs utilizing patents on the new and the mature technologies. As a result, the PSCs with high opportunities are revealed and patents related to the PSCs are examined. Then users of this system select some patents as resources for analogy. The system is tested by a case study of wireless charger technology. For the case study, 352 patents on wireless router technology and 227 patents on wireless charger technology are used. At the final, patents related to 'handoff', showed a high opportunity score and one of the patents is introduced to show the possibility of patent creation through analogy.

1. Introduction

Patents have many advantages for a successful business. By creating patents, a company can build entry barriers, earn profits through royalties, reduce the risk of patent litigation, and increase brand awareness. Especially when it comes to the new technology – a technology not yet commercialized and in an early stage of its life cycle – the advantages can be critical success factors of a business. For those reasons, many companies are trying to create patents on the new technology. For instance, about 113 applications of patents related to magnetic resonance battery charging technology were filed before 2010 (KIPO., 2011), even though the technology had not been commercialized in 2012.

A patent describes an invention, which means a solution to a specific problem (WIPO., 2004). The invention usually starts with identification of a specific problem. For instance, TRIZ, a theory developed in Russia for creative problem solving, presents methods for identification and definition of a problem at its first part (Al'tshuller, 1999). So, problem identification should be considered as one of the most important processes to create patents.

Research into problem identification methods has a long history in the management field. Quality function deployment, initially developed in Japan in the late 1960s, was designed to help transform customers' needs into engineering characteristics of products or services (Akao, 2004; Pahl & Beitz, 1984). Gradually, more-specific methods, such as the House of Quality (HOQ) (Hauser & Clausing, 1988) followed. Recently, outcome-driven innovation (ODI) was suggested as a new way of turning customer's input into innovation (Ulwick, 2002). Although these methods have differences, mostly they have been developed on the assumption that manufacturers pay attention to customers' opinions.

Other research has been conducted on TRIZ-related methods, such as contradiction theory, substance-field analysis, and technology evolution pattern (Al'tshuller, 1984; Al'tshuller, 1999; Al'tshuller, Altov, & Shulyak, 1996; Al'tshuller, Shulyak, & Rodman, 1999). Contradiction theory defines a problem as a contradiction of system parameters, such as weight, size, and speed. Substance-field analysis defines a problem as a simple interaction diagram of system components. Technology evolution pattern uses categorical directions, such as ideality, controllability, and complexity to identify the current level and the future direction of an existing system. Although these methods differ in many ways, they share the assumption that a physical system exists to be analyzed.

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The previous methods have limitations when applied to identify problems in the new technology. Assuming that the new technology is not yet commercialized, no users exist to express needs and problems, so customer-dependent methods are not applicable. Furthermore, if the development of a technology is in an early stage, physical prototypes may not exist, so physical-system-dependent methods are not applicable. Therefore, TRIZ-related methods are also difficult to apply. Consequently, identification of problems in the new technology often depends on insight of engineers, meaning that a support system must be developed.

In addition to the methods, there are design-by-analogy systems which can support patent creation. Design-by-analogy systems are methods or tools for concept generation or problem solving based on analogies between products (Linsey, 2007; McAdams & Wood, 2002; Verhaegen, D'hondt, Vandevenne, Dewulf, & Duflou, 2011). Early design-by-analogy systems are mostly developed with a case-based knowledge database (Bhatta & Goel, 1996; Maher, de Silva, & Garza, 1997; Sycara & Navinchandra, 1992; Watson, 1999). On the other hand, systems based on solution patterns or term relations were suggested (Al'tshuller, 1999; Al'tshuller et al., 1999; Linsey, 2007; Turney, 2005). Recently, as a result of an advancement of a text mining technology, patent-based solution search systems are suggested (Bryant, Stone, McAdams, Kurtoglu, & Campbell, 2005; Russo, Montecchi, & Ying, 2012; Verhaegen et al., 2011; Wang & Ohsawa, 2012). The existing design-by-analogy systems informed us that analogy is useful way to solve problems. However, there is lack of systems focused on a problem identification using analogy.

Meanwhile, patent analysis systems can be helpful to create patents. Most of the systems are designed to find technological or business-related trends (Daim, Rueda, Martin, & Gerdsri, 2006; Kim, Suh, & Park, 2008; Tseng, 2005). Recent patent analysis systems are using text mining technology to provide various functions, such as a term extraction, a statistical analysis, and a visualization (Lee, Yoon, & Park, 2009). However, it's hard to find systems providing functions to compare and to analyze different technologies simultaneously. We recognized that patent mapping methods can be one of the best way to compare different technologies so that users can easily generate ideas for new patents. This is a motivation of this research.

To remedy mentioned limitations, this research proposes an analogy-based patent mining system. The objective of the system is to support the creation of patents on the new technology. The system is developed under the assumption that similar problems would occur in technologies that have similar properties or functions. So the system is focused on identification of a problem solved concept (PSC) in relatively matured technology, named as the mature technology, whose property or function is similar to the new technology considered.

The PSC is a statement of what problem is solved in the patent (Phelps, 2007; Tiwana & Horowitz, 2009). So the PSCs are described as required functions, system errors, users' difficulties, and users' needs in the patents. In that point, the PSCs are similar concepts to customer requirements. However, there is a difference in viewpoints. The customer requirements are objects to fulfill in a perspective of a product designer. On the other hand the PSCs are objects to solve in a perspective of a problem solver. Because patents are much related to the latter, we use the PSCs rather than the customer requirements. Meanwhile, to extract and to analyze, the PSCs should be modeled. There can be options such as a single term, a word phrase, a sentence, and a paragraph. In this research, for simplification, a single term is selected to model the PSC and the term is named as PSC Term.

For a clear interpretation, the new technology is need to be defined. According to researches for Technology Life Cycle (TLC), technology is getting matured following four stages, which are youth, growth, maturity, and decline stages (Achilladelis, Schwarzkopf, & Cines, 1990; Andersen, 1999; Haupt, Kloyer, & Lange, 2007). And according to Technology Readiness Levels (TRLs) from NASA, there are nine stages for technology to be ready for a commercialization (Mankins, 1995). In this research, we regard the new technology is not yet commercialized. So in a perspective of TLC, the new technology should be on the youth stage. And in a perspective of TRLs, we can say that the new technology is on any stages before the end point.

On the contrary to the new technology, the mature technology is a relative concept. It just need to be more matured than the new technology considered. In this research, patents on the mature technology are used as resources for analogy. Typically on the way to be matured, technology experience accumulation of patents. So if the mature technology is on the maturity or the decline stages of TLC, the resources will be plentiful.

The proposed system is designed to deliver patents on the mature technology as resources for analogy (Fig. 1). First, the system discovers PSC Terms by analyzing patents on the mature technology which has similar property or function to the new technology considered. Then the system constructs a patent map based on similarities among all patents on the new and the mature technologies using the PSC Terms. Then the system identifies patent clusters for each PSC Terms and evaluates opportunity scores of each PSC Terms with a customized formula. Utilizing the opportunity scores, the system suggests patents on the mature technology in a patent cluster. Then users manually examine the patents and select some patents as resources for analogy. In this research, we named the selected patents as the reference patents.

Chapter 2 describes literature review, chapter 3 presents the methods of the analogy-based patent mining system, chapter 4 illustrates the proposed methods using patents related to wireless charger technology, and chapter 5 presents conclusions and future research.

2. Literature review

The proposed system can be regarded as the design-by-analogy system, because it supports analogy between two technologies. At the same time, the system can be regarded as the patent analysis system, because it utilize analysis of patents to support analogy. So existing systems related to the systems are reviewed in the first two parts of this chapter. Meanwhile, the proposed system is developed on the basis of three methods: a topic extraction method, a patent mapping method, and an opportunity evaluation method. So prior research related to the three methods are reviewed in the last three parts of this chapter.

2.1. Design-by-analogy system

The design-by-analogy system can be divided into a case-based analogy system, a theory-based analogy system, a patent-based analogy system, and a term-based analogy system according to information sources (Table 1). First, the case-based analogy system utilize design cases of a specific technological field as an information source. To build a database from the information source, system developers should interpret and classify design cases manually. And users explore the database to find design cases which can implement desired functions. For more than 20 years, most of the systems are utilized in an architectural field. The representative systems are Archie, Archie-II (Domeshek & Kolodner, 1992), Fabel (Voss, 1996), CADRE (Hua & Faltings, 1993) and SEED (Flemming, 1994). Meanwhile, KRITIK and KRITIK2 (Goel, Bhatta, & Stroulia, 1997) for physical design and Déjà Vu (Smyth & Cunningham, 1992) for software design are suggested. Recently, biological