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Abstract

Most organizations recognize the environmental scanning as a critical activity for strategic planning. The vast increase in the amount of publicly available information such as that on the Internet and the Web offers tremendous opportunities and poses some challenges to the scanning process. Traditional methods used for the environmental scanning do not support the search, analysis, and proper interpretation of the huge volume of available information in a timely manner. The recent developments in intelligent agent technology have a potential to support and manage the environmental scanning process. This research integrates agent technology with information retrieval techniques in order to design an effective environmental scanning system.

Introduction

Precise environmental scanning is critical to an organization because of greater uncertainty in the business environment. Environmental scanning can provide 'signals' for the organization; e.g., identifying threats and opportunities, and gaining competitive advantages (Stoffels 1994). Traditional scanning process heavily depends on the abilities of scanning personnel for collecting, analyzing, and interpreting information. However, the business environment has become more complex and uncertain than ever. Traditional methods are not capable of managing the comprehensive search, analysis, and proper interpretation of the vast amount of information currently available from various sources.

Intelligent agent technology has been used to search through the large volume of unstructured information. It can potentially be used for analyzing and interpreting collected information (Bradshaw, 1997; Caglayan and Harrison, 1997). King and O'Leary (1996) point to the potential use of intelligent agents in the competitive analysis, but little attention has been paid to the use of agent technology for the environmental scanning process.

Additionally, information retrieval techniques have been developed to help the classification of unstructured information (Belkin and Croft, 1992; Foltz and Dumais, 1992; Salton and McGill, 1983).

The focus of this research is to integrate agent technology with information retrieval techniques to search through the large volume of information available from information sources such as the World Wide Web, appropriately classify collected information, and help in interpretation and analysis to support the environmental scanning process.

Related Literature

This study spans over three areas: environmental scanning, intelligent agent, and information retrieval.

Fahey, King, and Narayanan (1981) found that most U.S. companies did not use sophisticated scanning systems. El Sawy (1985) suggests that a computer-based system for strategic scanning should be a customized personal system, very loosely coupled to the organizational information system. Yasai-Ardekani and Nystrom (1996) suggest that the contextual factors, such as organizational size, technology, and environmental change, should be aligned with the design of scanning systems.

Previous studies identified the issues related to the traditional environmental scanning process; e.g., information overload, bounded rationality, and information refineries (Clippinger and Konsynski, 1989; Elofson and Konsynski, 1991; Stoffels 1994). This study focuses on the issue of information overload and proposes that the agent technology be utilized for dealing with this.

Nwana (1996) provides a comprehensive overview of intelligent software agents and investigates and summarizes a broad range of agent type. Etzioni and Weld (1994) implement agent technology with a Unix shell and WWW to interact with a wide range of Internet resources. Sycara *et. al.* (1996) develop a distributed intelligent agent, called 'Retsina', in order to deal with issues of distributed information gathering in the Internet. Some researchers have developed information filtering agents such as WebWatcher, NewsWeeder, and NewsT (Armstrong, Freitag, Joachims, and Mitchell 1995; Lang 1995; Sheth 1994).

In this study, information retrieval techniques, such vector space model, latent semantic indexing, and relevancy feedback, are used with agent technology.

Agent-Based Environmental Scanning System

We propose a generic architecture for the scanning system, called an Agent-Based Environmental Scanning System (ABESS). The architecture incorporates:

- Assignment and coordination of intelligent agents to handle scanning activities such as gathering, classifying, interpreting, and analyzing
- Selection and utilization of specific techniques to intelligently and automatically manage information.

The ABESS consists of:
- *Interface Agent*: to communicate with single or multiple users,
- *Information Agent*: to gather information from internal and external sources and monitor information sources for a change,
- *Knowledge Agent*: to classify collected information, and interpret and analyze classified information.
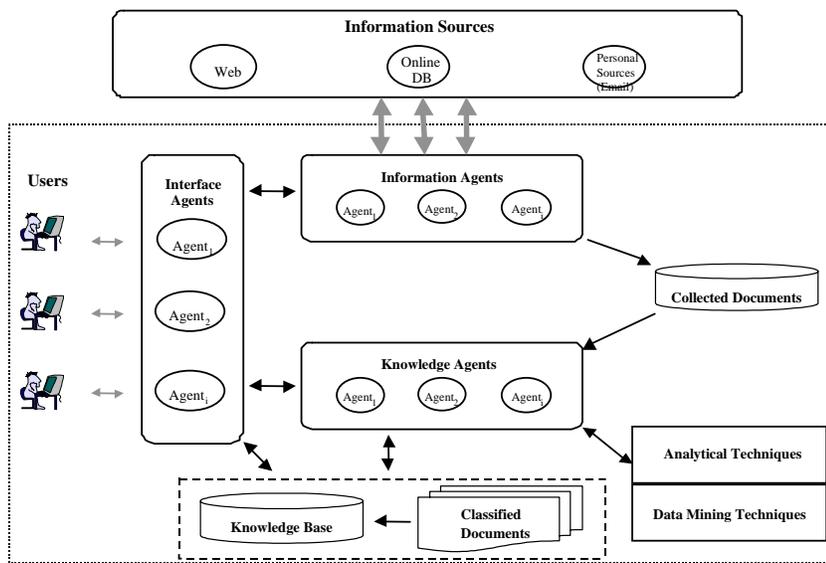
Figure 1 shows the ABESS in detail.

The focus of this research is on the tasks of knowledge agents. Following issues related to knowledge agents are investigated,
- How knowledge agents transform collected data into relevant information or knowledge,
- How knowledge agents integrate the transformed information with strategic objectives,
- How to disseminate the discovered knowledge for the strategic decision making.

Following section describes the knowledge management process to resolve the previous issues.

The knowledge management process includes four major parts: building the user profile, filtering and classifying by comparing the profile, integrating classified data with knowledge base, and analyzing classified data by using analytical and mining techniques.

Figure 1. Overview of an Agent-Based Environmental Scanning System

Building Profiles

For developing the user profile, common features such as author, date, subject and the body of a document, are extracted. Author field is used to assess the reliability and significance of the document. Date field is used for updating purpose. Extracted features from subject field are weighted higher than those from document bodies. The profile consists of a list of terms, which is extracted from common features, and statistics for each term.

Filtering Documents

Data collected during the scanning process contain a wide range of topics and are mostly semi-structured or unstructured. The contents may be volatile. To deal with this, the filtering process must be flexible and efficient. The proposed system uses two retrieval techniques: a term-based best match and Latent Semantic Indexing (LSI). A term-based best match provides reasonable retrieval outputs through the statistical measures and performs efficiently in terms of the processing speed.

When retrieving and filtering *continuously changing data*, efficiency is more critical to the system than effectiveness. LSI provides semantically rich outputs, and can effectively be applied to *static data*.

Integrating with Knowledge Base

Filtered information is integrated with the knowledge base using the following three operations,
- *Add:* to attach the new document to the knowledge base by creating links to related documents,
- *Update:* if the document already exists in the knowledge base, the old document is replaced with the recent one,
- *Purge:* the uninteresting and/or out-of-date documents are removed from the knowledge base.

The algorithm for the Add operation is shown in Figure 2.

Analyzing Classified Data

After the classified information is integrated with the knowledge base, knowledge agents help analyze it according to the request or interest of senior managers. The analysis and interpretation of classified information is based on analytical and mining techniques.

The proposed system will be validated by employing it in a mid-western utility company. The effectiveness of the proposed system will be investigated.

Expected Contributions

This study proposes a framework for utilizing intelligent agents in the scanning process. It facilitates a theoretical investigation into the design of an intelligent agent-based system for supporting strategic planning. The results of study are expected to provide insight into how the agent technology can be implemented in order to resolve the issue of information overload. For MIS practitioners, this study provides guidelines for designing and implementing environmental scanning systems.

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