Data Mining and Mobile Business Data

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INTRODUCTION

Research and practices in mobile (m-) business have seen an exponential growth in the last decade (CNN, 2002; Leisen, 2000; McDonough, 2002; Purba, 2002). M-businesses allow users to access information, perform transactions and other operations from anywhere at anytime via wireless networks. Consequently, m-business applications are generating a large volume of complex data (Magic-sw, 2002). Monitoring and mining of this data can assist m-business operators to make sound financial and organisational decisions.

Data mining (DM) or knowledge discovery in databases is the extraction of interesting, meaningful, implicit, previously unknown, valid and actionable information from a pool of data sources (Dunham, 2003). This valuable and real-time information inferred from the data can be used for decision-making. For example, common use of mobile phones and personal digital assistance (PDAs) has increased the number of service providers. The DM technology can help providers to develop services and sales strategies for future benefits. An example of existing applications of data mining in m-business is MobiMine (Kargupta, Park, Pittie, Liu, Kushraj, & Sarkar, 2002), which enables a user to monitor stock prices from a handheld PDA.

BACKGROUND: PROCESS OF KNOWLEDGE DISCOVERY

Data mining - an interactive, iterative, non-trivial process - is usually divided into many subtasks (Figure 1). Prior to commencing the mining process, businesses should identify and define their goals, objectives and limitations. Accordingly, data is gathered and collated from multiple sources as each source may send data in different formats. The next phase is to ensure quality of the data by removing noise, handling missing information and transforming to an appropriate format. A reduced volume of the data set " representative of the overall processed data " is also derived by applying data reduction techniques.

Once the data is pre-processed, an appropriate data mining technique or a combination of techniques is applied for the type of knowledge to be discovered (Table 1). The discovered knowledge is then evaluated and interpreted, typically involving some visualization techniques. When the mined results are determined insufficient, an iterative process of performing preprocessing and mining begins until adequate and useful information is obtained. Lastly, the information is presented to user to incorporate into the company's business strategies.

Figure 1. The data mining process

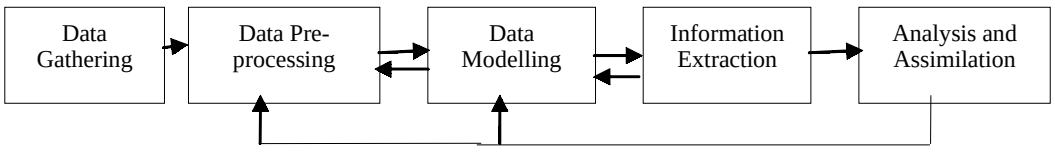

Table 1. Various data mining tasks

Mining Task	Goal	Approaches
Predictive Modelling	To predict future needs based on previous data	Decision tree, Neural networks
Clustering	To partition data into segments	Demographic, Neural networks
Link Analysis	To establish association among items	Counting occurrences of items such as Apriori Algorithms
Deviation Detection	To detect any anomalies, unusual activities	Summarization and Graphical representation

DATA MINING OPPORTUNITIES IN M-BUSINESS DOMAIN

Taking Advantage of Location Information

With the Global Positioning System (GPS) mobile technology, it is possible to identify the location of users (Cousins & Varshney, 2001; Duri, Cole, Munson, & Christensen, 2001). Based on the locations that a person frequents most and the personal information given, it is possible to classify the user in a pre-defined category with data mining techniques. For example, if a person is most often sighted in supermarkets, department stores and at home, and is seen shuttling between sales events, then this person can be classified as a possible homemaker interested in sales events. In terms of a business-to-consumer relation, such information allows businesses to provide the appropriate marketing information to the specific category of users.

In terms of a business-to-business relation, the ability to track the location of the employees is ideal to determine the work efficiency of the employees. Analysis of employee's time spent on the duty will determine the employee who is performing best and most suited for the next pay increment and promotion. Businesses like courier companies are dependent on the information regarding the locations of the transported parcels. Data mining techniques are able to analyse various routes and time spent in receiving parcels over a period. The outcome determines the efficiency of the business processes and factors behind their failure or success.

Personalization of M-Business Applications

Due to the limited screen space provided on mobile devices, it is difficult for mobile users to browse the product or service catalogues on the devices. It is important for vendors to provide only the products or services that match the needs of individual users. Short message service (SMS) is used primarily for simple person-to-person messaging. Information obtained from analysing the user data about previously accessing these services can be used to create personalized advertises to the customer delivered by SMS (Mobilein.com, 2002).

Relevant services can be offered based not only on the personal profile of the device holder, but also on the device holder's location and time factor. For example, m-business applications used in the travel industry can assist users to find attractions, hotels and restaurants of their preference on requested location and time. The *clustering data mining* technique groups the customers with similar preferences. When a new customer mentions his preferences, a recommendation can be made based on the previous similar preferences. *Associative data mining* can be used to indicate which places a person is most likely to visit in a single trip or in two consecutive trips, with having inputs such as location and time of visits to attractions for each user. This provides great convenience for users as these services can be used while driving, for example, a suggestion can be made based on the association rule that if the user is on place A then the user should visit the place B, previous 80% visitors have done so.

Predicting Customer Buying and Usage Patterns

Service providers can analyse the consumer behaviour data (e.g., by analysing gateway log files and content server log files on WAP) and predict the consumers buying and usage patterns, or to understand how mobile subscribers use their wireless services. Using the stored data, companies can apply data mining to identify customer segments using *clustering data mining techniques*, to distinguish customers' consumption patterns using *deviation detection techniques*, and transaction trends using *associative data mining techniques*. This information can then be used to provide better services to the customers or to attract potential customers.

Predicting Future and Better Usage of Mobile Technology

Data, about the number of mobile phones in the market, the number of users subscribing a service, the amount of usage measured in currency, the users' satisfaction and feedback, can be extracted and analysed with data mining. The resulting information can be used to predict the trends and patterns of usage of mobile phones and services. For example, some of the popular services bought through m-commerce technology are mobile ringing tones, logos and screensavers. The most common used interface for these kind of transactions are short message service (SMS) and the standard e-commerce interface, the Internet. An example is Nokia's focus on screensavers, logos and ringing tone availability. This is most likely to be a result of previous research on their users' trends, by capturing the data on the users' demands and needs, and then analysing the users' feedbacks. This information helped Nokia to develop a new market product where the product is no longer just a mobile phone, but also provides extra features like SMS, logos and additional ringing tones and screensavers (Nokia, 2002).