

Multimedia Information Filtering

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INTRODUCTION

In the film *Minority Report* (20th Century Fox, 2002), which is set in the near future, there is a scene where a man walks into a department store and is confronted by a holographic shop assistant. The holographic shop assistant recognises the potential customer by iris-recognition technology. The holographic assistant then welcomes the man by his name and starts to inform him of offers and items that he would be interested in based on his past purchases and what other shoppers who have similar tastes have purchased. This example of future personalised shopping assistants that can help a customer find shopping goods is not too far away from becoming reality in some form or another.

Malone, Grant, Turbak, Brobst, and Cohen (1987) introduced three paradigms for information selection, *cognitive*, *economic*, and *social*, based on their work with a system they called the Information Lens. Their definition of cognitive filtering, the approach actually implemented by the Information Lens, is equivalent to the “content filter” defined earlier by Denning, and this approach is now commonly referred to as “content-based” filtering. Their most important contribution was to introduce an alternative approach that they called social (now also more commonly called collaborative) filtering. In social filtering, the representation of a document is based on annotations to that document made by prior readers of the document.

In the 1990s much work was done on collaborative filtering (CF). There were three systems that were considered to be the quintessential recommender systems. The GroupLens project (Miller, Albert, Lam, Konstan, & Riedl, 2003) initially was used for filtering items from the Usenet news domain. This later became the basis of Movielens. The Bellcore Video recommender system (Hill, Stead, Rosenstein, & Furnas, 1995), which recommended video films to users based on what they had rented before, and Ringo (Shardanand & Maes, 1995), which later was published on the Web and marketed as Firefly, used social filtering to recommend movies and music.

BACKGROUND

Filtering multimedia content is an extensive process that involves extracting and modeling semantic and structural information about the content as well as metadata (Angelides, 2003). The problem with multimedia content is that the information presented in any document is multimodal by definition. Attributes of different types of media vary considerably in the way the format of the content is stored and perceived. There is no direct way of correlating the semantic content of a video stream with that of an audio stream unless it is done manually. A content model of the spatial and temporal characteristics of the objects can be used to define the actions the objects take part in. This content model can then be filtered against a user profile to allow granular filtering of the content, allowing for effective ranking and relevancy of the documents.

Filtering has mainly been investigated in the domain of text documents. The user’s preferences are used as keywords, which are used by the filters as criteria for separating the textual documents into relevant and irrelevant content. The more positive keywords contained in a document, the more relevant the document becomes. Techniques such as latent semantic indexing have found ways of interpreting the meaning of a word in different contexts to allow accurate filtering of documents using different syntax, but allow the same semantics to be recognised and understood.

Text documents adhere to the standards of the language they are written in. Trying to do the same for AV data streams, you are faced with the problem of identifying the terms in the content itself. The terms are represented as a series of objects that appear in the content, for example, a face in an image file. These terms cannot be directly related to the objects as there is no method of comparison, or if there is, it is complex to unlock. The title of the document and some information might be provided in the file description, but the actions and spatial and temporal characteristics of the objects will not be described to a sufficient level for effective analysis of relevancy.

MAIN THRUST OF ARTICLE

Information-filtering techniques have been applied to several areas including American football (Babaguchi, Kawai, & Kitahashi, 2001), digital television (Marusic & Leban, 2002), Web applications (Kohrs & Merialdo, 2000), and ubiquitous and pervasive device applications (Tseng, Lin, & Smith, 2002).

Filtering multimedia information requires different approaches depending on the domain and use of the information. There are two main types of multimedia information filtering: collaborative and content based. If the user wants a subjective analysis of content in order to find a recommendation based on their individual preference, then they use collaborative filtering, also known as social or community-based filtering. If, on the other hand, they require an objective decision to filter information from a data stream based on their information needs, then they use content-based filtering.

All of the above systems use either collaborative or content-based filtering or a combination of both (hybrid) as the techniques for recommending predictions on candidate objects. There are existing information-filtering models outside these classic techniques such as temperament-based filtering (Lin & McLeod, 2002), which looks at predicting items of interest based on temperament theory. It works on the same principle as social filtering. Unlike social filtering, the users are grouped on temperaments of the users and not on similar item selection.

Content-Based Filtering

Content-based filtering is suited to environments where the user requires items that have certain content features that they prefer. Collaborative filtering is unsuitable in this environment because it offers opinions on items that reflect preferences for that user instead of providing filtering criteria that tries to disseminate preferred content from a data stream based on a user's preference. Personalised video summaries are the perfect domain to use content-based filtering. The reason for this is that a user will be interested in certain content only within any video data stream. For example, when watching a football game, the user may only be interested in goals and free kicks. Therefore, users can state what content features and other viewing requirements they prefer and then filter the footage against those requirements.

The content-based approach to information filtering has its roots in the information retrieval (IR) community and employs many of its techniques. The most prominent example of content-based filtering is the filtering of text objects (e.g., mail messages, newsgroup postings, or Web pages) based on the words contained in their textual representations. Each object, here, text documents, is assigned one or more index terms selected to represent the best meaning of the document. These index terms are searched to locate documents

related to queries expressed in words taken from the index language. The assumption underlying this form of filtering is that the "meaning" of objects and queries can be captured in specific words or phrases. A content-based filtering system selects items based on the correlation between the content of the items and the user's preferences as opposed to a collaborative filtering system that chooses items based on the correlation between people with similar preferences (van Meteren & Someren, 2000).

The main problem with content-based filtering is that it does not perform well in domains where the content of items is minimal and the content cannot be analysed easily by automatic methods of content-based retrieval (e.g., ideas and opinions). Users with eclectic tastes or who make ad hoc choices are given bad recommendations based on previous choices. For example, Dad, who usually buys classic rock CDs for himself, purchases a So Solid Crew album for his 12-year-old son. He may start getting recommendations for hardcore garage dance anthems every time he logs in. CF does not suffer this problem as it will rank on other users' recommendations of similar choices. Comparative studies have shown that collaborative-filtering recommender systems on the whole outperform content-based filtering.

Collaborative Filtering

A purely content-based approach to information filtering is limited by the process of content analysis. In some domains, until recently, the items were not amenable to any useful feature extraction with content-based filtering (such as movies, music, restaurants). Even for text documents, the representations capture only certain aspects of the content, and there are many others that would influence a user's experience, for example, in how far it matches the user's taste (Balabanovic, 2000).

Collaborative filtering is an approach to overcome this limitation. The basic concept of CF is to automate social processes such as "word of mouth." In everyday life, people rely on the recommendations from other people either by word of mouth, recommendation letters, and movie and book reviews printed in newspapers. Collaborative filtering systems assist and augment this process and help people in making decisions.

There are two main drawbacks to using collaborative filtering: the sparsity of large user-item databases and the first-rater problem (Rashid et al., 2002). Sparsity is a condition when not enough ratings are available due to an insufficient amount of users or too few ratings per user. An example of sparsity is a travel agent Web site, which has tens of thousands of locations. Any user on the system will not have traveled to even 1% of the locations (possibly thousands of locations). If a nearest-neighbour algorithm is used, the accuracy of any recommendation will be poor as a sufficient amount of peers will not be available in the user-item database. The

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