CHAPTER 53

TECHNOLOGY
COMPUTER ENGINEERING

Doctoral Theses

01. BHOOPENDRA KUMAR
Design of Channel Allocation and Power Control Strategies for Efficient spectrum Utilization in Cognitive Radio Networks.
Supervisors: Prof. Sanjay Kumar Dhurandher
Th 27134

Abstract

The world has seen revolutionary changes in the area of the communication for last few decades. Nowadays, communication has become the integral and very important part of everyone's life. It has changed the way we live, talk, move, think, commerce, study and so on. Wireless radio spectrum is the backbone of this entire scintillating structure. In the recent years, wireless applications and services have grown tremendously, resulting to a shortage of radio spectrum. Many recent studies show that most of the available spectrum has already been allocated. Static allocation of radio spectrum has resulted not only in the scarcity of the availability of spectrum bands, but also the underutilization of the available bandwidth as well. On the one hand, most of the available radio spectrum has already been allocated to different users and service providers. While on another hand, research and statistics have revealed that the spectrum utilization is very limited. To address this dilemma, the concept of cognitive radio (CR) has emerged, which enables the use of dynamic spectrum access, where secondary users (SUs) or unlicensed users are allowed to opportunistically use the spectrum when it is not being used by the primary users (PUs) or licensed users. CR provides a new dimension in the field of wireless communication and is considered as a life line for the spectrum scarcity problem. CR is a rising technology that unlocks the doors for radio spectrum scarcity seen all around the world nowadays. The protection of PUs is vital when SUs use the licensed spectrum bands. Medium Access Control (MAC) protocols use the sensing capability and the primary users behaviour to generate the transmission opportunities for the SUs. Two fundamental access methods namely overlay and underlay are very popular in utilizing the free available channels or the white spaces in the cognitive radio networks (CRNs). Firstly, this work provides a comprehensive survey of overlay and underlay techniques and then compares them qualitatively based on the several network parameters. Next, it also simulates overlay and underlay transmission techniques in OMNeT++ simulator on different network parameters, namely, primary user arrival rate, throughput, sensing duration, and energy consumption. Here, the Research findings reveal that neither the overlay nor the underlay technique is sufficient itself to fulfill the demands for the future wireless systems and adopting a hybrid access technique consisting of a joint utilization of the overlay and underlay approaches is the most desirable. Thereby, a hybrid approach is very much required for taking the full benefit of the transmission opportunities generated due to the behavioural patterns of the PUs. Various hybrid access methods have been proposed and

recommended by the many researchers to further enhance the radio spectrum utilization. Of course, the hybrid access methods are the better ways to deal this spectrum scarcity problem, but at the same time a comprehensive and directed effort is required to optimize the modality of these hybrid spectrum access methods.

Contents

02. SINGH (Viomesh Kumar)
Design and Analysis of Recommender System.
Supervisors: Prof. Sangeeta Sabharwal and Prof. Goldie Gabrani
Th 26921

Abstract

This is the era of the Internet Web 2.0, mobile phones, smart devices, and social networks where information is growing explosively. This exponential growth in data has inundated users with vast amounts of information, leading to a significant challenge known as information overload. While the available information can be used for decision-making, one of the major problems is of information volume being huge which requires extensive time and effort to analyze the information, and most of the time it creates confusion as well. Manual processing of such information becomes arduous for humans, and finding the relevant information becomes increasingly difficult. Recommender Systems enable online users to cope with the information overload problem and support various decision-making processes by providing the most important and relevant information that is likely to interest customers and assist them in making better decisions. Recommender Systems are crucial in multiple industries like e-commerce, streaming media, and social networking platforms such as Netflix, Amazon.com, YouTube, Spotify, and Facebook, among others. These systems offer recommendations of highly relevant items to users, aiding them in making informed decisions. As a result, businesses may experience an increase in sales, customer loyalty, and click-through ratios, and have the opportunity to introduce a wider range of products in the market. Collaborative filtering, an eminent approach of recommendation, find the similarity in the data records to recommend the items. The performance of collaborative-based recommendation depends on the effectiveness of the clustering algorithm used for finding the similarity, especially in big data environments. In this thesis, First, a new approach is proposed to determine optimal similarity patterns which is a new variant of the grasshopper optimization algorithm. Second, the proposed optimization method ExpGOA has been leveraged to present a new clustering-based collaborative filtering method “Exponential GOA collaborative method (ExpGOA-CM)”, to perform efficient recommendations. Third, we propose a novel fuzzy clustering-based recommender system using grasshopper optimization algorithm and Map-Reduce. In this proposed work, (i) A novel variant of the grasshopper optimization algorithm, improved grasshopper optimization algorithm (IGOA), is proposed. (ii) A new parallelized recommendation method, IGOA-based fuzzy clustering using MapReduce (MR-IGOAFC), is introduced for efficient recommendation with quick response on massive dataset. The proposed methods are validated on various benchmarks and compared with existing approaches to highlight their strength.

Contents

03. TIWARI (Devendra)
Method of Extraction and Analyzing Information in Compound Document Image.
Supervisors: Dr. Anand Gupta
Th 26922

Abstract

Digitizing paper documentation and turning it into an editable electronic version is a challenge to extract the Text, Table, or Figure region from a document image, numerous strategies have been devised. However, previous research indicates that these strategies are ineffective for handling papers combining two or more regions. Extracted content needs to be organized in terms of its semantic style and formatting to make document recreation easier. Support the requirement for a combined technique to extract each of these zones and the necessity of effectively arranging the acquired data. The effective two-stage CDIA-DS (Compound Document Image Analysis-Data Structure) framework addresses the abovementioned requirements. The document image`s regions are initially recognized and categorized as Views in the first step. In conclusion, tests are performed to gauge CDIA-effectiveness DS`s when employing the suggested data structure. Table extraction (TE) from composite document images (CDI) is currently challenging for computer vision. The CDI contains elements like text, images, and tables that provide difficulties in extracting them separately and positioning them correctly. Because the text in an image may be low contrast, different in style, size, alignment, orientation, and complicated background, TE`s primary goal is to extract only helpful information. This work includes Four steps in the TE process: pre-processing, text separation, text extraction, and reconstruction. Here, pre-processing is done using the Guided Image (GI) filter, which removes image artifacts like noise and varying illumination. Next, a better binomial threshold separates the text from an image (IBT). Using Harris Hawk algorithm-tuned Deep Neural Network (DNN), the exact text is recovered from compound DI (HHOA). The final step is to reassemble the complete document into an editable file. Python is the platform used to carry out this task. The UNLV, TableBank, and ICDAR 2013 table competition dataset, which is freely accessible, was utilized to assess the proposed DNN-HHOA algorithm. As part of Tesseract OCR, the performance is validated regarding precision metrics. For the tabular data to be further processed by downstream activities like semantic modeling and information retrieval, the Table Structure Recognition (TSR) challenge tries to recognize the structure of a table and turn the unstructured tables into a structured and machine-readable format. In this study, we postulate that a complex table structure can be represented by a graph whose vertices and edges, respectively, stand in for the cells and the connections between them. Then, the ResNet attention network optimized with the BWME Optimization algorithm is formulated to extract table structure to maintain the relational integrity of the tabular data. The experimental results show that the suggested strategy outperforms state-of-the-art methods on a variety of datasets that we used earlier.

Contents