Personalized multimedia content retrieval using hybrid approach

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Abstract. Nowadays, due to an ever increasing number of the multimedia content available, users of multimedia devices find it more and more difficult to find a content suitable for them. Web search engines, online shops, news portals, digital video archives are just some examples of applications in which users encounter such problem.

To tackle this problem, systems for user modeling and personalized retrieval of the multimedia content are being developed. To personalize the selection of the multimedia content, these systems take into account a variety of information about users, from demographic information to users' content preferences. Many different methods have been used to accomplish personalization and the three main groups of methods are content-based, collaborative and hybrid approaches. In this work we focus on content-based and hybrid techniques.

In this thesis we present our idea of an intelligent hybrid system for personalized retrieval of the TV and video content. The system will include an innovative multi-step content-based filtering module, which will first calculate the similarity between users' models and descriptions of the content on the level of content metadata attributes and this will be followed by a classification of the vector of attributes similarities using machine learning methods. Our goal is to find the optimal function to compute attributes similarities for a maximum filtering precision. For collaborative filtering a module developed in our previous research will be used.

Hybrid filtering of the content will be carried out using a new adaptive method for content retrieval that identifies the quality of basic modules for content retrieval. This method will include the calculation of the adaptive weighted sum where the weights for the content retrieved by content-based and collaborative filtering methods will adapt to users and their interaction with the system. We will consider several features of content-based and collaborative approaches and try to find the ones that assure the greatest degree of confidence in the results of the approaches.

In the next phase of our work we will try to further improve the results of content-based filtering using new content attribute - subtitles. With subtitles we will address the issue of insufficient content descriptions. Subtitles will be processed with the LSA method and will be used both as an additional attribute in the metadata structure as well as the only attribute in the content descriptions.

In the last part of the thesis the module for content retrieval explanations will be added to the hybrid filtering module. To increase the users' experience and satisfaction with the system, each retrieved and presented content item will be accompanied with an explanation why the system believes this item is appropriate for him/her. We will experiment with different factors that affect content retrieval. Additionally, users' feedback to the presented explanations will be used to update user profiles and improve the performance of content-based filtering.

The proposed methods will be tested on two datasets. EachMovie is a publicly available dataset with a large number of test users and content and we will also develop our own test environment which will include a smaller set of users and content but will allow us to test the proposed methods for explanations of content retrieval.

An integrated solutions to ensure the EMV compliance using RFID interrogator in payment systems

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Abstract. Development of the Radio Frequency IDentification systems in high frequency the range (13.56 MHz) is strongly present in everyday life. In recent years, such systems have progressed from conventional RFID tag to smart active labels (SAL) able to provide additional information about their environment (temperature, humidity, alcohol, etc.) besides the fixed data stored in the tag. The next step is to implement the RFID technology in payment systems (EMV).

Basically, the RFID infrastructure is intended to record and track data and generally does not meet the specifications laid down by the EMV. It is therefore most important to design an RFID reader that would meet the EMV requirements, particularly in the part guaranteeing the reliable communication, and also to comply with regulations imposed on, electromagnetic compatibility (EMC/ETSI/FCC). Speaking in terms of safety and compliance, with the set regulations the main goal is to design a highly integrated RFID reader having only a few external discrete elements to allow for reader operation.

The major part of this dissertation will be on research, optimization and evaluation of a integrated decoder sub circuits, reader control circuit, and system for low-energy tag-detection system.

A high-level approach for functional verification of digital integrated circuits

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Abstract. With everyday growing demands, complexity of electronic devices is constantly increasing. Since simulation is still the most used approach, functional verification has become one of the major bottlenecks in the Design and Verification Flow (DVF).

In this thesis we propose a systematic approach to configurable functional verification of electronic devices. Based on a black-box approach, it can be applied on any design where behavior can be expressed by a set of functions. It combines a simulation- and assertion-based verification into a hybrid verification. The proposed specification-based coverage metric can be configured from a very fast to an exhaustive verification. The approach uses Transaction Level (TL) modeling and SystemC to raise the abstraction level providing a faster verification. Both results of the proposed DVF, i.e. Intellectual Property (IP) and Test Bench (TB), are reusable. IPs are advised to be reused in various designs, thus eliminating an unnecessary verification time with each new design. A TB once used on a TL can be reused on a register transfer level by introducing a transactor.

The approach is demonstrated on two case-studies; a video processing IP block and universal
serial bus host controller. The results consider both simulation times and TB generation times.

Modeling and analysis of the heterojunction third-generation solar cells

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Abstract. To get a better insight into the functioning of the heterojunction third-generation solar cells, in their analyzing we use numerical modeling and simulations, instead of experiments which are often time-consuming and expensive. Research in the solar-cell operation principles and developing new models, that are indispensable in laying down modern simulation programs, are some of the activities of the Laboratory of Photovoltaics and Optoelectronics (LPVO) running at the Faculty of Electrical Engineering, University of Ljubljana, under the leadership of prof. Dr. Marko Topič. Miha Filipič, a researcher of the National Young-researcher Scheme, under the supervision of prof. Dr. Franc Smole, in his doctoral dissertation, investigates the heterojunction amorphous/crystalline silicon solar cells and the dye-sensitized solar cells. The main advantages of the former are the high open-circuit voltage exceeding 700 mV and a low drop in efficiency when increasing the cell temperature. Modeling of these cells will be made in two dimensions to enable analyzing advanced concepts of cells with contacts on the back side. Quantum effects (for example trap-assisted tunneling) also have an important role in these cells and a detailed description of tunneling mechanisms will be included in the model. By developing numerical models that will provide the basis for our simulation programs, we will be able to get an insight into how to improve heterojunction silicon solar cells.

The principle of operation of the second type of solar cells to be addressed in the doctoral thesis i.e. the dye-sensitized solar cells, is quite different from that of the solar cells with a pn-junction and is closer to photosynthesis. The light is not absorbed in the semiconductor material but in the dye molecules attached to a porous semiconductor with a large band gap (TiO2, ZnO), where electrons are transported to the contacts. The main advantages of these cells are their simple manufacturing process and low cost. In our thesis, the functioning of these cells will be analyzed, thus providing the basis for developing a numerical model of the entire dye-sensitized solar cell.

Voltage fluctuation in industrial power networks and compensation measures

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Abstract. The theme of the proposed doctoral dissertation are power quality and modern compensation devices used in power systems. As the existing power systems are increasingly operating closer to the limits of their stability, there is a growing risk of their partial or complete collapse which at the same time reduces quality supplied of the electricity. Using compensation devices based on power-electronic elements is one of the alternative approaches to solving the today's power systems issues. These devices compensate the reactive power by means of which the load on the transmission lines is decreased and additional transmission capacity is provided, thus positively affecting the power quality at the lower distribution level.

One of the major problems of modern power systems are the oscillations of the voltage signal which disturb the luminous flux of electric lamps – known as flicker. Sources of flicker are all the electricity sources causing rapid changes in the voltage level and thereby distorting the voltage signal in the power system.

The focus of this doctoral dissertation is on some of the possibilities for compensating and reducing the flicker levels in the power system. A new control algorithm for thyristor-controlled series reactor to reduce the flicker level in the power system is presented.

By comparing the actual current value and the reference (ideal) current value, it is possible to predict the value of the inductance/capacitance to be added to the system to reduce current fluctuations in the network. Advantages and disadvantages of the developed algorithm are analyzed too.