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Current Research Interests

- [Hardware systems – Radio Frequency Identification.](#)
- [Hardware systems – Video.](#)
- [Computer - aided design, optimization and simulation of electronical circuits.](#)
- [Computer systems for real-time activity monitoring](#) - communications protocols for local-area networks, database management, multitasking systems.
- [Fast algorithms for the discrete wavelet transform.](#)
- [Signal processing](#) - statistical estimators, wavelet transform, denoising.
- [Patent for invention concerning computer security.](#) - [Diploma and Silver Medal.](#)
- [Patent for invention in RFID systems.](#)

Other information

- [Short biography](#)
- [Overview of past works](#)
- [Partnership Certificate](#) issued by Philips Semiconductors for works on anticollision methods for radio frequency communication.
- [Certificate of Achievement](#) issued by SafeGames, Inc. for a CCD based video system for real time activity monitoring.
- [Excellent Paper Award](#) at SIITME 2005 Conference for Synchronization of RFID Readers at Low Antenna Distances with Avoidance of Mutual Disturbances.
- [Best Paper Award](#) at SIITME 2006 Conference for Improving the Reliability of Detection of RFID Tags by Synchronous Demodulation with Programmable Phase Shift.
- [Best Oral Presentation Award](#) at SIITME 2010 Conference for RFID Readers for the HDX Protocol - Design, Simulation and Testing.

Short Biography

Dr. Vuza was born in 1955 in Bucharest, Romania.

He graduated in 1978 receiving the Praiseworthy Diploma. His graduation work, *Approximation Schemes for Variational Inequalities*, was written under Academician Gheorghe Marinescu's supervision. Further on he attended one-year specialization courses in Functional Analysis at the same faculty. His specialization work, *Strongly lattice-ordered modules over function algebras*, was written under Academician Romulus Cristescu's supervision.

He obtained the Doctor degree in Mathematics from the University of Bucharest in 1984, with the thesis *Modules over commutative ordered rings* written under Academician Romulus Cristescu's supervision.

Dr. Vuza worked as a mathematician (1979 - 1983) and as a researcher in mathematics (1983 - 1989) in the Department of Mathematics of the National Institute for Scientific and Technical Creation (INCREST) in Bucharest. Since 1990 he is working as a senior researcher in mathematics in the Institute of Mathematics of the Romanian Academy. Since 1996 he holds the position of senior researcher degree I at the named institute.

Dr. Vuza is a member of the Committee for Functional Analysis of the Romanian Academy.

His works on the theory of [principal modules and their applications to linear operators](#) were awarded the Prize "Simion Stoilov" by the Romanian Academy in 1987.

In 2002 Dr. Vuza was awarded a prize for his scientific activity by the National Foundation for Science and Art of the Romanian Academy.

Dr. Vuza was invited to participate in several international conferences, including:

- the international conference on *Operator Algebras, Ideals, and Their Applications in Theoretical Physics*, Leipzig, Germany (1983);
- the conference *Aspects of Positivity in Functional Analysis* in the honor of H. H. Schaefer, Tübingen, Germany (1985);
- the seminar *Riesz Spaces and Operator Theory*, Oberwolfach, Germany, (1985 and 1989);
- the German - Polish seminar on *Banach Spaces Theory*, Georgenthal, Germany (1986 and 1989);
- the seminar *Riesz Spaces and Operator Theory*, Oberwolfach, Germany (1989);
- the international conference on *Functional Analysis and Approximation Theory*, Acquafredda di Maratea, Italy (1989, 1992 and 1996).

He was also invited to give lectures at the following scientific institutes:

- the Department of Mathematics of Collège Militaire Royal of Saint-Jean-sur-Richelieu, Canada (March 1994);
- the Department of Mathematics of the National Technical University of Athens, Greece (April 1994);
- the Computational School of Vico Equenze, Italy (September 1994).

During 1994 - 2000, Dr. Vuza collaborated with the Institute for the Applications of Mathematics from Naples (Italy) on the topics of [estimations of signals from samples affected by noise](#) and [fast algorithms for wavelet transforms](#). He was visiting the named institute in 1994 when awarded a NATO-CNR fellowship, in 1995 when invited by the institute and in 1996 in the framework of the protocol of the session of the 12-th Italian - Romanian Commission for scientific and technological cooperation.

Dr. Vuza received Romanian Academy Grants in 1997 and 1998.

During September 1995 - October 1995, March 1996 - April 1996 and October 1998 - May 1999 he collaborated with SafeGames Inc. and Mikohn Gaming Corporation, both of Las Vegas (U.S.A.) on developing several [systems for real-time activity monitoring](#).

Presently Dr. Vuza works on the topic of [Radio Frequency Identification Systems](#). He collaborated with SafeGames Inc., Philips Semiconductors, Gaming Partners International (Beaune, France) and Frosch Electronics (Graz, Austria) on developing several systems for communication with transponders.

Dr. Vuza holds a patent for an [ISA Extension Card and Method for Protection of IBM-PC and Compatible Computers against Unauthorized Persons Use](#) issued by the Romanian State Office for Inventions and Trademarks (OSIM). This invention has been awarded a [Diploma and Silver Medal](#) at the 31-th International Salon of Inventions in Geneva, April 3003. He also holds a patent for [Method of managing a plurality of electronic microcircuit chip readers and equipments for implementing said method](#) issued by US Patent Office.

Radio Frequency Identification (RFID) Systems

Dr. Vuza collaborated with Philips Semiconductors Gratkorn (Austria) on the topic of anticollision methods for radio frequency communication between read-write devices and multiple data transponders. The methods have been developed with the aid of computer simulations and finally adapted and tested on a concrete device of the above-mentioned manufacturer. Dr. Vuza's work on this topic is testified by the Partnership Certificate issued by Philips Semiconductors.

Dr. Vuza started collaborations with Gaming Partners International, Beaune (France) in 2003 and with Frosch Electronics, Graz (Austria) in 2005 on the subject of development of devices for communication with RFID transponders. The following systems have been produced so far as results of these collaborations.

- Method and Device for Synchronization of Several RFID Readers at Low Antenna Distances with Avoidance of Mutual Disturbances – Designed for Gaming Partners International; [patent](#) issued by US Patent Office.
- RFID Reader Based on the Atmel AT91SAM7S64 Micro-Controller – Designed for Gaming Partners International in collaboration with Frosch Electronics.
- RFID Reader Based with Integrated Display – Designed for Gaming Partners International.
- Long range RFID Reader Based on the Atmel AT91SAM7S64 Micro-Controller – Designed in collaboration with Frosch Electronics.
- Low cost proximity RFID Reader Based on the Atmel AT91SAM7S64 Micro-Controller – Designed in collaboration with Frosch Electronics.
- HDX protocol add-on module for the proximity RFID Reader – Designed in collaboration with Frosch Electronics.
- Long range 13.56 MHz RFID Reader for ISO/IEC FDIS 18000 and ISO/IEC FCD 15693 Reader – Designed in collaboration with Frosch Electronics.
- Method for Synchronization of Several 13.56 MHz RFID Readers at Low Antenna Distances with Avoidance of Mutual Disturbances – Designed for Gaming Partners International in collaboration with Frosch Electronics.



Philips Semiconductors Gratkorn, Austria, certifies that Dr. Dan Tudor Vuza, senior researcher at the Institute of Mathematics of the Romanian Academy, has implemented enhanced anticollision firmware for the Philips reader micro controller, with the purpose of fast retrieval of serial numbers of all transponders inside the field of the reader antenna. Dr. Vuza evaluated the general principles of anticollision and generated a working version on the Philips HITAG read/write device HTRM800.

We therefore hereby certify Dr. Vuza's expertise in the domain of Radio Frequency Identification and acknowledge him as a very valuable partner for the RFID market.

On behalf of Philips Semiconductors

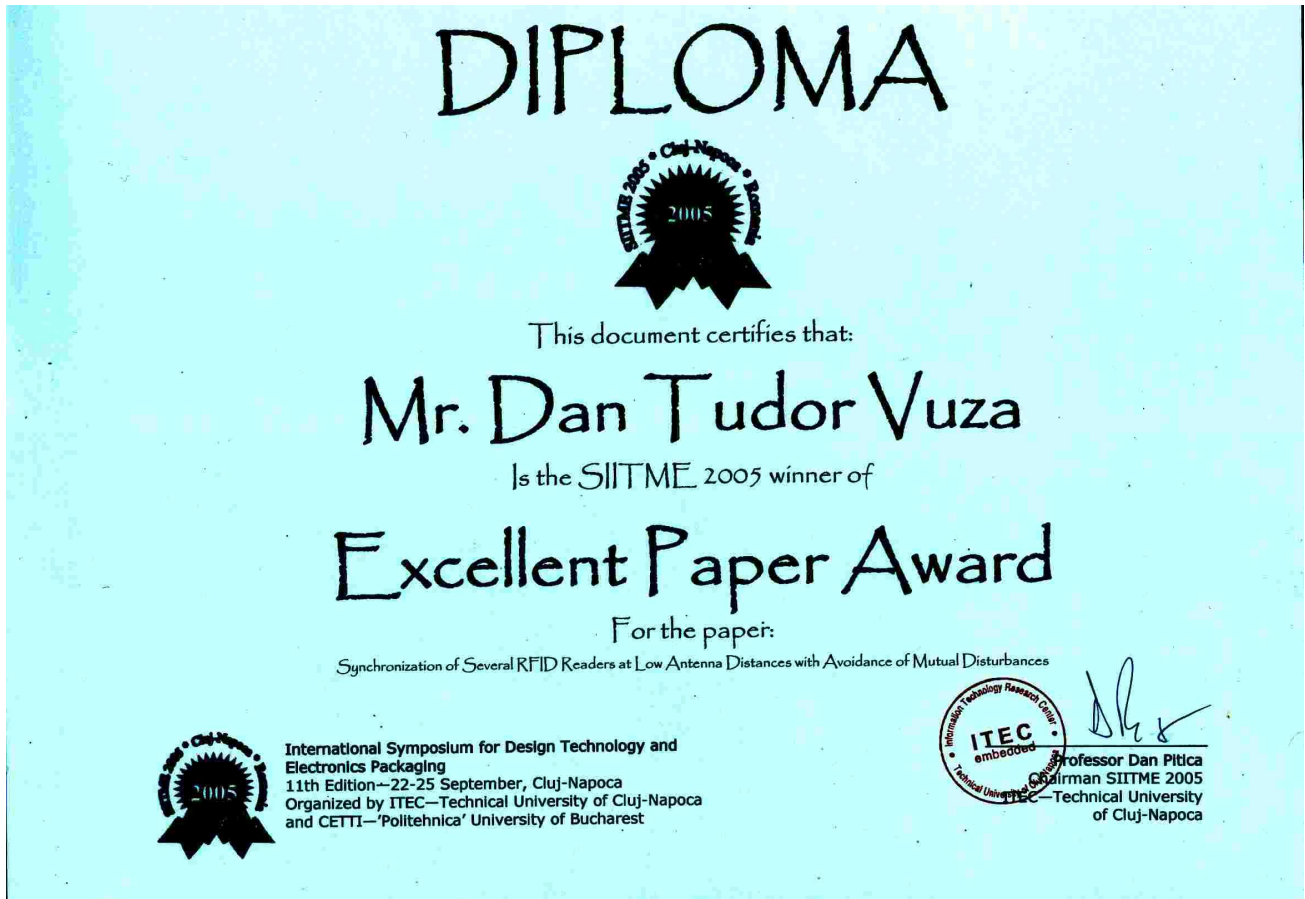


PHILIPS
 Philips Semiconductors Gratkorn GmbH
 Mikron-Weg 1, 8101 Gratkorn, Austria
 Tel: +43 3124 299 0, Fax: +43 3124 299 330
 Kurt Bischof
 Product Manager HITAG

Gratkorn, 27th Feb 2001

Partnership Certificate issued by Philips Semiconductors for works on anticollision methods for radio frequency communication.

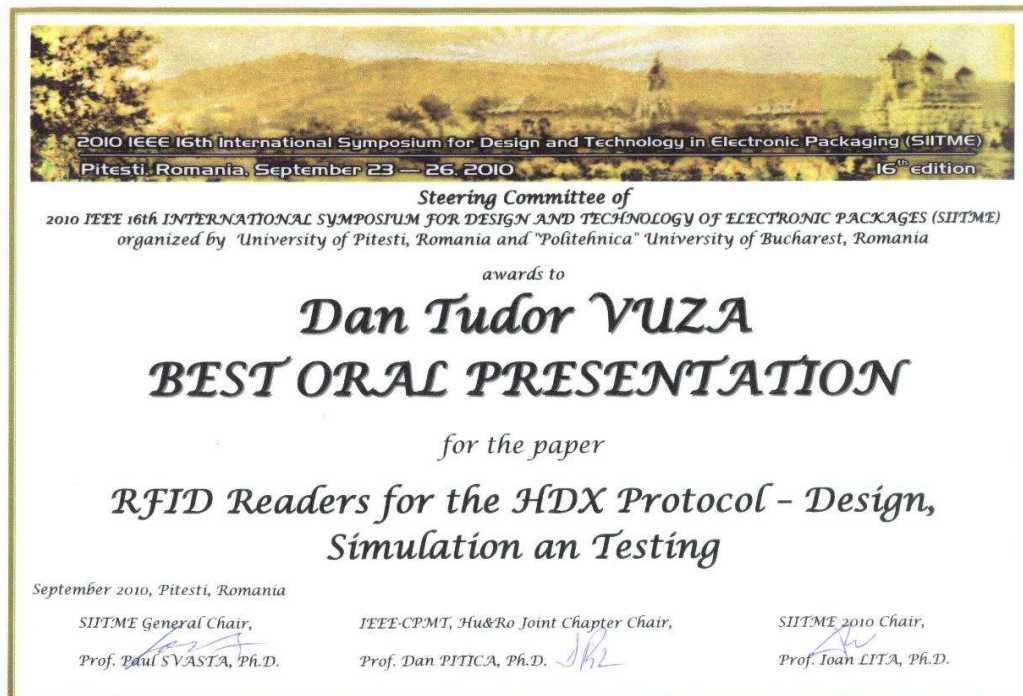
**Awards at the International Symposium for Design Technology and Electronics Packaging (SIITME)
for works in RFID**



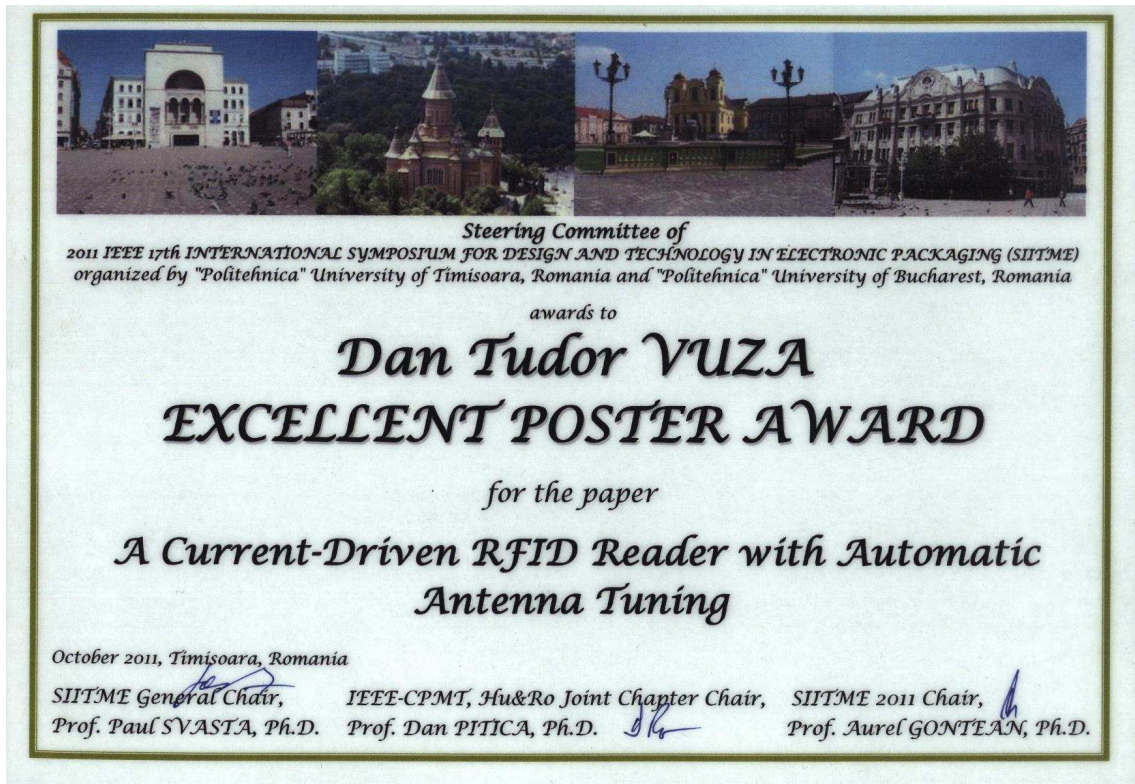
Excellent Paper Award at the 2005 SIITME Conference



Best Paper Award at the 2006 SIITME Conference



Best Oral Presentation Award at the 2010 SIITME Conference



Excellent Poster Award at the 2011 SIITME Conference



Best Paper Award Poster Session at the ATOM-N 2014 Conference



Best Paper Award Plenary Session at the ATOM-N 2016 Conference

Patent for invention in RFID systems

Method of managing a plurality of electronic microcircuit chip readers and equipments for implementing said method - United States Patent 7382229

Two RFID readers with antennas situated in proximity and working simultaneously would disturb each other and make data retrieval not possible, even if the antennas would be separated by 125 cm. With the aid of the synchronization method and device of the invention, it was possible to have three readers working in good conditions with antennas as close as 20 cm. The method includes transmitting, in a first time interval, command instructions from each of the plurality of readers to the electronic microcircuits of the chips associated with each respective reader; and receiving, in a second time interval, responses from the electronic microcircuits of the chips associated with each respective reader. The first and second time intervals do not overlap.



US007382229B2

(12) **United States Patent**
Vuza

(10) **Patent No.:** **US 7,382,229 B2**

(45) **Date of Patent:** **Jun. 3, 2008**

(54) **METHOD OF MANAGING A PLURALITY OF ELECTRONIC MICROCIRCUIT CHIP READERS AND EQUIPMENTS FOR IMPLEMENTING SAID METHOD**

(75) Inventor: **Dan Tudor Vuza**, Bucarest (RO)

(73) Assignee: **Gaming Partners International**,
Savigny-les-Beaune (FR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 290 days.

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(Continued)

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(21) Appl. No.: **10/541,319**

AU 6854690 9/1991

(22) PCT Filed: **Apr. 7, 2005**

(Continued)

(86) PCT No.: **PCT/FR2005/000850**

OTHER PUBLICATIONS

§ 371 (c)(1),
(2), (4) Date: **Jun. 30, 2005**

English Language Abstract EP 0815504.

(87) PCT Pub. No.: **WO2006/106192**

(Continued)

PCT Pub. Date: **Oct. 12, 2006**

Primary Examiner—Brian Zimmerman

Assistant Examiner—Yong Hang Jiang

(65) **Prior Publication Data**

(74) Attorney, Agent, or Firm—Greenblum & Bernstein, P.L.C.

US 2007/0167134 A1 Jul. 19, 2007

(51) **Int. Cl.**
H04B 7/00 (2006.01)

(52) **U.S. Cl.** **340/10.2; 455/41.2; 340/10.3**

(58) **Field of Classification Search** **340/10.2, 340/825.2, 10.3; 714/712-715; 370/310, 370/321, 324, 345**

See application file for complete search history.

(56) **References Cited**

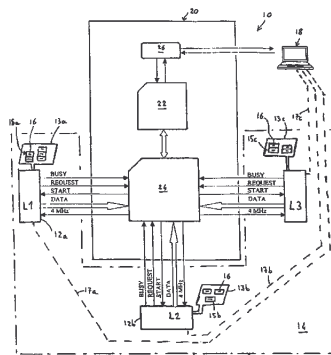
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(57) **ABSTRACT**

Method and system for coordinated management of a plurality of contactless radio-frequency readers of chips incorporating electronic microcircuits. The method includes transmitting, in a first time interval, transmit operations composed of command instructions from each of the plurality of readers to the electronic microcircuits of the chips associated with each respective reader; and receiving, in a second time interval, receive operations composed of responses from the electronic microcircuits of the chips associated with each respective reader. The first and second time intervals do not overlap.

18 Claims, 5 Drawing Sheets



First page of patent description including invention abstract.

ISA Extension Card and Method for Protection of IBM-PC and Compatible Computers against Unauthorized Persons Use

Invention realized in collaboration with Dr. Marian Vladescu (Electromagnetica Goldstar, Bucharest).

The invention is referring to an ISA extension card and a method ensuring the protection of IBM-PC compatible computers against usage by non authorized persons. The invention consists of an ISA extension card endowed with an EEPROM memory, a program for user identity check and management of the list of users having access rights to the computer, and electronic circuits for the protection of the secret of the program code and of the user data. On every power-on of the computer, the program in the EEPROM memory asks the user to enter the name and the password, then allows the loading of the operating system only if the input data match those already stored in the EEPROM memory. The user identification data can be input via keyboard, via floppy disk or by combining these two. The electronic circuits protect against any attempt to access the program code or the user data, whatever would be the software attack method. The address interval occupied in the space reserved for ISA cards is minimal and no I/O port addresses are used.

(19) OFICIUL DE STAT
PENTRU INVENȚII ȘI MĂRCI
București

ROMANIA



(11) Nr. brevet: **116510 B1**

(51) Int.Cl.⁷ G 06 F 12/14;

(12) **BREVET DE INVENȚIE**

Hotărârea de acordare a brevetului de invenție poate fi revocată
în termen de 6 luni de la data publicării

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Nr.

(22) Data de depozit: **19.01.1999**

(62) Divizată din cererea:
Nr.

(30) Prioritate:

(86) Cerere internațională PCT:
Nr.

(41) Data publicării cererii:
BOPI nr.

(87) Publicare internațională:
Nr.

(42) Data publicării hotărârii de acordare a brevetului:
28.02.2001 BOPI nr. **2/2001**

(56) Documente din stadiul tehnicii:
EP 0670063; US 4951249

(45) Data eliberării și publicării brevetului:
BOPI nr.

(71) Solicitant: **VOZA DAN TUDOR, BUCUREȘTI, RO; VLĂDESCU MARIAN, BUCUREȘTI, RO;**

(73) Titular: **VOZA DAN TUDOR, BUCUREȘTI, RO; VLĂDESCU MARIAN, BUCUREȘTI, RO;**

(72) Inventatori: **VOZA DAN TUDOR, BUCUREȘTI, RO; VLĂDESCU MARIAN, BUCUREȘTI, RO;**

(74) Mandatar:

(54) **CARTELĂ DE EXTENSIE ISA ȘI METODĂ PENTRU PROTECȚIA
CALCULATOARELOR IBM-PC ȘI COMPATIBILE ÎMPOTRIVA
FOLOSIRII DE CĂTRE PERSOANE NEAUTORIZATE**

(57) **Rezumat:** Invenția se referă la o cartelă de extensie de tip ISA și o metodă ce asigură protecția calculatoarelor IBM-PC și compatibile împotriva utilizării de către persoane neautorizate. Invenția constă dintr-o cartelă de tip ISA, alcătuită dintr-un bloc de memorie de tip EEPROM (1), un bloc decodor (2), un bloc comutator de pagini de memorie (3), un bloc de control (4) și un conector standard ISA (5) și este prevăzută cu un program de verificare a identității utilizatorului pe baza unei parole ce poate fi introdusă prin intermediul tastaturii calculatorului, printr-un disc flexibil sau prin combinarea ambelor modalități și de gestiune a listei utilizatorilor cu drept de acces la calculator și circuite electronice care asigură secretul programului și al datelor asociate cu utilizatorii. Metoda de protecție asigură imposibilitatea accesului la codul programului și la datele asociate cu utilizatorii, oricare ar fi procedeul software de atac folosit. Cartela ocupă un interval de memorie rezervat în spațiul de adrese de memorie rezervat cartelelor ISA și nu face uz de spațiul de adrese de porturi I/O.

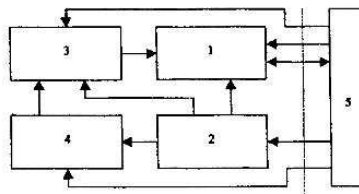


Fig. 1

Revendicări: 8

Figuri: 6

RO 116510 B1



First page of patent description including invention abstract.

DIPLÔME



SALON INTERNATIONAL DES INVENTIONS GENÈVE

Après examen, le Jury International a décidé
de remettre à: Dan Tudor VUZA et Marian VLADESCU

pour l'invention: Carte d'extension ISA pour la protection des
ordinateurs IBM PC

UNE MEDAILLE D'ARGENT Genève, le 11 avril 2003


Le Rapporteur du Jury


Le Président du Comité
d'Organisation du Salon

Diploma and Silver Medal awarded at the 31-th International Salon of Inventions in Geneva, April 2003.

CCD Based Video System for Real Time Activity Monitoring

This research was part of a collaboration with SafeGames, Inc., Las Vegas, US (www.sglv.com). It was aimed at the development of an integrated monitoring system that is able to capture an image in response to the signal triggered by a sensor and to deliver an information extracted from that image to an attached personal computer.

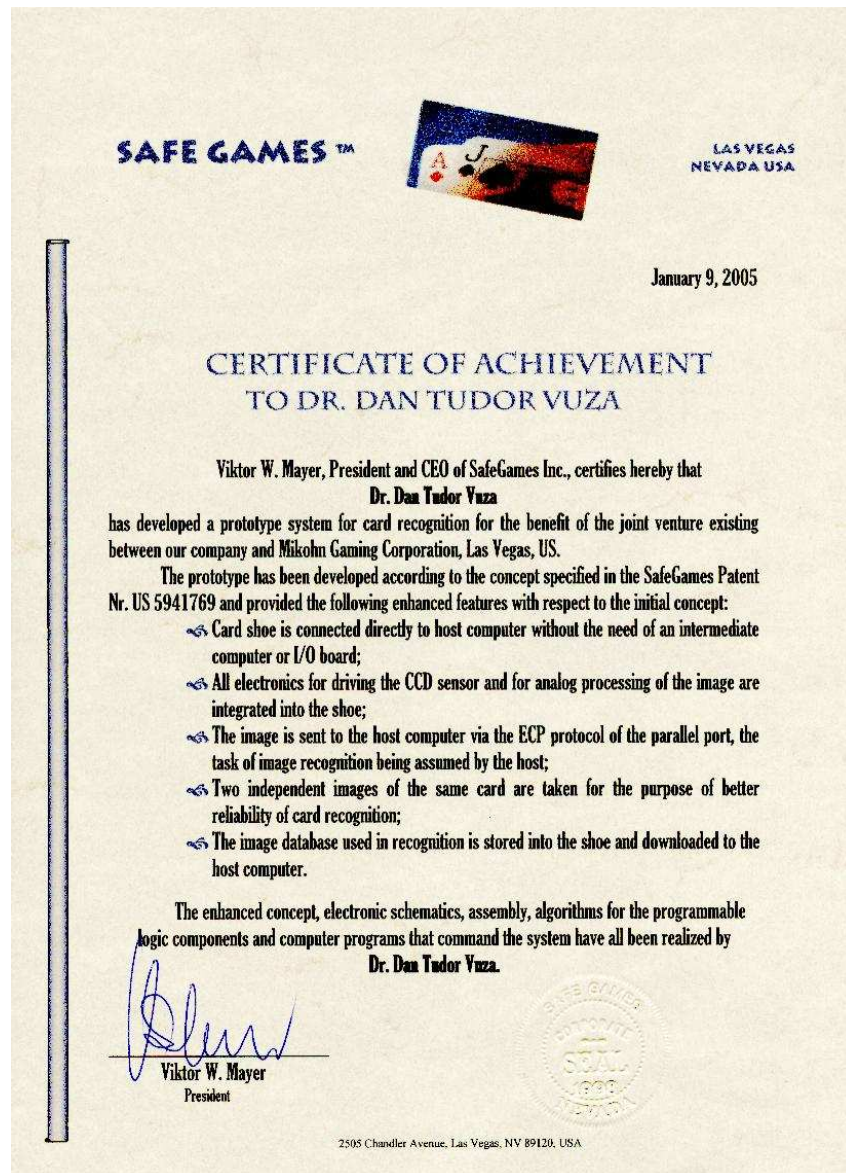
The system is a mixed analog-digital design.

The analog part has to ensure the proper processing of the image signal delivered by a CCD sensor with emphasis on image stability, electrical offsets elimination and noise reduction.

The logic part has to perform several functions:

- coordinating the sequence of actions, from image acquisition to information delivery to the attached PC;
- managing the communication protocol between the system and the PC;
- maintaining the CCD sensor in the ready state during non active periods (in particular, taking care of the dark noise reduction) as the video acquisition is not continual but is triggered by a hardware signal.

The system makes use of a microcontroller for realizing the above functions, while the low level and high speed functions related to CCD driving signals and communication protocol are provided by programmable logic of CPLD type.



Dr. Vuza's work on this topic is testified by the document Certificate of Achievement issued by SafeGames, Inc.

Optimal Design of Circuits for Optoelectronic Devices

Dr. Vuza collaborated between 1998 – 2002 with Senior Engineer Dr. Marian Vladescu from Electromagnetica Goldstar on a series of researches concerning the optimal design of circuits for optoelectronic devices, focusing on optoelectronic sensors. The results obtained were concerned with the comparative evaluation of performances of optoelectronic sensors based on different types of synchronous demodulation, by employing both theoretical methods (Fourier analysis) as well as numerical experiments (SPICE simulations). The results made the subject of the papers [66] – [68] in the list of works.

Network protocols for real-time monitoring of independent processes.

A system for monitoring of independent processes would consist of a central workstation connected via a local network to several computers dedicated to specialized tasks of different kinds. The purpose is to collect data from these tasks in real time and store them in a central database. The system should meet the following requirements:

- reliability of the involved network connections, including minimization of network collisions;
- multitasking approach in order to be able to deal simultaneously with a large number of connections;
- rate of data transmission adjustable independently for each connection;
- protection from data losing by combined use of the central database and of local storage at each computer on the net;
- ease of extensibility, allowing addition of new data processing modules to the central program with minimum effort, as processes of new types are added on the net;
- compatibility with database standards, allowing the central database to be processed with existing tools.

Such a system was developed in 1995 and 1996 by Dr. Vuza as a part of a multinational project initiated by Mikohn Gaming Corporation and is certified by the document **Certificate of Achievement and Accomplishment** issued by the named company.

Artificial Intelligence - based System for Activity Monitoring

The purpose of the system is to monitor the activity at a game table in real time and to transmit the information to a central station. It consists of the following components.

- Data acquisition modules, that collect data relevant to game activities from several optical sensors and radio-frequency devices.
- A data processing module, that employs Artificial Intelligence for reconstructing the players' decisions and the dealer's actions by filling the gaps in the limited information provided by the previous modules.
- A data communication protocol for sending data to a central station.
- A custom-built multitasking system that allows the subprocesses which control the various devices in the system to run concurrently.

Such a system has been developed by Dr. Vuza during his participation to the SafeGames project initiated and supervised by SafeGames Inc. and Mikohn Games Corporation, both of Las Vegas, U.S.A, and was presented at *World Gaming Congress & Expo*, Las Vegas Convention Center, September 1999.

Fast algorithms for the wavelet transform.

This research was carried out in collaboration with Dr. Umberto Amato while visiting Istituto per Applicazioni della Matematica of Naples, Italy.

The discrete wavelet transform (DWT) has proved its utility in various signal processing problems such as data compression or noise reduction. It is therefore important, both for research and for industrial applications, to dispose of fast software performing the various versions of the DWT. Several software tools for this purpose were designed by Dr. Vuza, which are currently used in the activity of the named institute. Since Wavelet Theory is relatively new, software product adapted to specific needs are not easy available yet so that we had to develop our own.

An object-oriented approach to the DWT by developing a hierarchy of C++ classes covering the cases of periodic DWT and finite-interval DWT has been proposed . The code was presented in two versions:

- as C++ code, designed to be portable to all C++ platforms and hence intended primarily for research;
- as assembly language code, designed for integration into real-time applications based on INTEL processors of 80386 type or higher.

The assembly version was optimized for speed by means of a non-standard use of the floating-point unit in order to achieve the following purposes:

- reducing the number of memory references by making use of all eight floating-point unit registers (in contrast with usual compilers, which generally use up to three of them);
- ensuring a high degree of sequentiality of execution stream by reducing the number of jumps.

Both 16 bit and 32 bit versions were produced.

The table below presents a comparison between the timings achieved with the C++ and assembly versions respectively. The test consisted in running the DWT for 200 times on a sequence of 4096 data and taking the average execution time, expressed below in milliseconds. The test was performed on a 90 Mhz PENTIUM computer running Windows for Workgroups 3.11 with the Win32s add-on.

	16 bit code	32 bit code
C++ code	166.14	52.45
ASM code	26.36	16.75

It is expected that applications based on processors not as highly optimized as the PENTIUM (in particular, those without branch prediction) could take an even greater advantage from the proposed assembly routines. A possible research subject could be therefore the adaptation of the above methods to other types of DWT beside periodic and finite interval and to other kinds of processors.

For applications it is equally important to dispose of filter coefficients for DWT computed to a high precision. In the report mentioned below the authors proposed a program for the MATHEMATICA environment for computing the boundary filter coefficients needed by the finite interval DWT which takes advantage of the capability of MATHEMATICA of working with arbitrary high degrees of precision. Research on this topic could also be continued for other types of DWT.

Reference from list of works related to this topic: technical report [1].

Signal processing: denoising, statistical estimators and wavelets.

This research was carried out in collaboration with Dr. Umberto Amato while visiting Istituto per Applicazioni della Matematica of Naples, Italy.

The research was concerned with the problem of the wavelet transform and its applications to one-dimensional data (signals) and two-dimensional data (images). One of the considered subtopics was data denoising by means of Tikhonov regularization of the wavelet coefficients. Compression capabilities of wavelets reveal useful not only in picking the significant part of information contained in a signal, but also in suppressing the noise affecting the signal, without degrading it too much. A regularization technique has been devised, which, together with the Generalized Cross Validation criterion (GCV) for choosing the proper amount of smoothing, gives rise to a very simple completely objective method for smoothing data. Comparisons, both theoretical and experimental, were made with the denoising techniques, developed by Donoho and Johnstone in a statistical framework, on some test problems from the literature and on a true problem coming from interferometry.

The effectiveness of wavelet regularization as a denoising device is mainly due to the fact that the true signal is compressed by the wavelet transform in a "few" coefficients, so that most of the coefficients in the wavelet expansion of the noisy signal are due to the noise contribution. When the signal is periodic, the mentioned effect is achieved by using the periodic wavelet transform. For non periodic signals however, such a compression is no longer obtained due to the boundary discontinuities so that the regularized solution is affected by artificially induced oscillations. To avoid this difficulty a wavelet transform for non periodic functions on an interval has been used, based on a newly developed method by Cohen, Daubechies, Jawerth and Vial. Numerical experiments on one-dimensional and two-dimensional data confirmed the removal of boundary effects.

A modified variant of GCV for the case of correlated noise affecting the data has been proposed.

The regularization method has been generalized to Besov spaces and to more general regularizing functionals. It has been proved in particular that other techniques for smoothing data (such as various statistical estimators) can be viewed as solutions of regularization problems.

References from list of works related to this topic: papers [56] - [60], [62] - [65].

Overview of past works

The bibliographical references in the text below are found in the enclosed list of works.

The theory of principal modules and its applications to the study of regular operators: [16] - [19], [21], [23], [24], [28], [32], [34], [35], [52], the book [3].

The notion of a principal module was introduced in the INCREST preprint 62/1980 *Strongly lattice ordered modules over function algebras* (published at a later date as [17] and [18]). The theory of principal modules comprises two components : the study of algebraic and topological properties of these modules; the study of principal modules of linear operators.

In the INCREST preprint 100/1981 *Extension theorems for strongly lattice - ordered modules and applications to linear operators* the principality permanence theorem was proved. The theorem was also stated in [16], [19], [21]. A systematic study of the applications of the permanence theorem to majorization problems in operator theory has been done. These problems, which received consideration from the part of many researchers during the past decade, had as a general theme the discovery of subclasses C of $L_r(E, F)$ with the property that the relations $0 \leq S \leq T$, S belongs to $L_r(E, F)$ and T belongs to C imply S belongs to C . As classical examples of majorization theorems, one could mention the theorem of Dodds and Fremlin on compact operators and the theorem of Lozanovskii, Buhvalov and Schep on band properties of the space of integral operators. Although the statements of these two theorems have in common the aspect proper to a majorization problem, their original proofs have very few things in common. By using the permanence theorem of the theory of principal modules it was possible to elaborate a unified method for the study of majorization problems which allowed to redemonstrate, on a common basis, most of the known majorization theorems (in particular the ones mentioned above) and to find new results.

Among the new results found with the aid of that method, one mentions the results in [19] and [28] on approximable operators and the results in [19], [21] and [28] on the relation between the order ideal and the closed algebraic ideal generated by a regular operator.

The theory of oru-compact operators: [29], [33], [36].

A class of regular operators which possess moduli even if the target space is not order complete.

General theory, the relation with almost integral operators in the sense of G. Ya. Lozanovskii, the relation with integral operators.

The theory of strongly latticial classes: [35].

Methods of construction of spaces of regular operators which possess moduli and their applications to majorization problems.

Contributions to the study of integral operators: [29], [34], [36], [40], [41], [52].

Contributions to the problems of the intrinsic characterization of integral operators and of the characterization of some particular classes of integral operators (Carleman, Hilbert-Schmidt) in terms of algebraic ideal properties.

The theory of Convolution Type Operators, which provides a unified framework for the study of order properties of several classes of operators including integral, convolution, change of variable operators and Radon transforms.

Contributions to the theory of factorization of compact operators: [39], [44].

Contributions to the study of abstract Riesz spaces and of the operators on these spaces.

The Riesz decomposition property for complex Riesz spaces [7], the construction of the perfect M-tensor product [16], the relation between almost integral operators and finite rank operators [34], the extension of Riesz space valued operators [6], [10], the extension of operators invariant with respect to a semigroup [5], [10], the relation between the weak Fatou property and the Egoroff property [22], the integral representation of regular operators (the book [3]).

Contributions to the mathematical theory of music: [11] - [15], [20], [25], [27], [30], [31], [38], [43], [46] - [49], [54], the textbook [2].

The applications of algebraic structures (especially groups and their actions) and of discrete harmonic analysis to music theory, searching for adequate mathematical modeling of some classes of musical phenomena, especially those involving periodicity. In this context a model [26] intended for the study of periodic rhythm was proposed.

The study in four parts *Supplementary Sets and Regular Complementary Unending Canons*, published in *Perspectives of New Music*, is concerned with the applications of discrete harmonic analysis (convolution and Fourier transform on the groups \mathbf{Z}_n) to the theory of unending rhythmic canons. The notion of supplementary sets turned out to be a mathematical model adequate for the study of the regularity properties and the construction of the named canons.

Other contributions.

Measure theory, differential manifolds, topological groups, the theory of Alfsen and Effros, operatorial characterizations of Hilbert spaces, reflexive spaces of operators on Hilbert spaces.