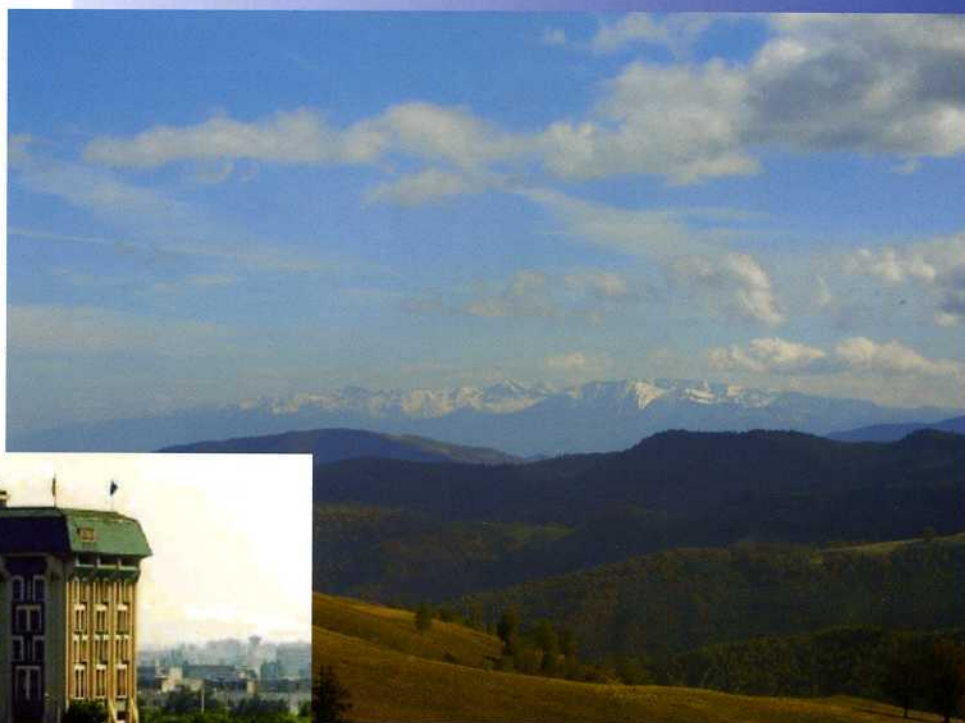


September 18-21, Predeal, ROMÂNIA

SIITME 2008

Conference proceedings



International Symposium
for Design and Technology
of Electronic Packaging

14th Edition, Predeal, România
Organized by
TRANSILVANIA University of Brasov



September 18 – 21, Predeal, Romania

SIITME 2008

conference proceedings

**International Symposium
for Design and Technology
of Electronic Packaging**

14th Edition

TABEL OF CONTENTS

Experimental Studies Regarding the Shielding Properties of Nano-materials Using the TEM Cell <i>Adrian Mailat, George Nicolae</i>	1
The Simulation and Measurement of Signal Attenuation through Materials <i>Radu Toev, Mihai Scutaru, Petre Ogrutan, Gheorghe Morariu</i>	6
A Model for Electromagnetic Shielding Evaluation Applied to Nanomaterials <i>Petre Ogrutan, Lia-Elena Aciu, Gheorghe Pana</i>	11
Microcontroller Based Embedded System for Unconventional Power Source Management <i>Adrian Mailat, Petre Ogrutan, Carmen Gerigan, Peter Gal</i>	16
Overview on Shielding Effectiveness Measurement Methods for Conductive Materials <i>Lia-Elena Aciu, Petre Ogrutan, Mihai Bădic</i>	21
Programmable Delay Line for High Speed Signal Acquisition <i>Casalin Negrea, Marius Rangu</i>	26
Class E, 0–100W, 4MHz, Variable Power Plasma Generator <i>Dorin Petreus, Emil Platan, Alin Grama, Sergiu Cadar</i>	31
A Low Cost Reader for Anticollision and Animal Identification <i>Reinhold Frosch, Dan Tudor Vuza, Helmut Koeberl, Damien Boissat</i>	36
Simulation of Multiple ISO/IEC 18000-2:2004 Transponders with the AT91SAM7S64 Controller <i>Reinhold Frosch, Dan Tudor Vuza</i>	41
Design of Microwave Filters with Cross-Couplings by Using Electromagnetic Simulations and Linear Circuit Optimization <i>George Lojewski, Nicolae Militaru, Marian Gabriel Banciu</i>	46
Equivalent Models #study of Supercapacitors Behavior <i>Alin Grama, Dorin Petreus, Ramona Gălbăuș, Ionuț Ciocan</i>	50
Supercapacitors Study: Modeling and Sizing <i>Ramona Gălbăuș, Dorin Petreus, Ionuț Ciocan, Alin Grama</i>	55
Direction Characteristics of the Heat Transfer Coefficient in Convection Reflow Oven Part I: Parameters and Gas Flow Model <i>Baldzs Illés</i>	60
Direction Characteristics of the Heat Transfer Coefficient in Convection Reflow Oven Part II: Measurements and Discussion <i>Baldzs Illés</i>	65
Biological Inspiration in Optical Investigation of Artworks from the National Cultural Heritage <i>I. Petrescu, T. Mureșan, R. Solovăstru, O. Gui, F. Todor, A. Bokor</i>	70
Improved Solution For Local Clock Programing In Gals Designs <i>Razvan Jipa</i>	75
ActivVisionTools Software Used in Semiconductor Chips Production as a Machine Vision Application <i>Cristian Damian, Ileana Damian, Victoria Soare, Constantin Brunesco</i>	80
Reliability of Pb-free Solder Joint Under Different Test Conditions <i>Alena Pietrikova, Juraj Durisin, Jan Urbancik</i>	85
Performance Analysis of Wireless Sensor Networks in Industrial Environment for Remote Control <i>Mihai Machedon-Pisu, Adrian Nedelcu, Florin Sandu, Iuliu Szekely, GheorghMorariu e</i>	89
Automatic Navigation for Robots <i>Paul Mugur Svasta, Iaroslav-Andrei Hapenciu</i>	94

A New Method to Calculate the Pospieszalski Model Noise Parameters for a HEMT Transistor <i>Julian Cherecheș, Radu Gabriel Bozomitu</i>	101
A VLSI Implementation of a CMOS Fully Differential Clock Recovery Circuit <i>Radu Gabriel Bozomitu, Vlad Cehan</i>	106
Reliability Aspect of Polymer Thick Film Interconnections in Hybrid Circuits <i>Ján Urbančík, Alena Pietriková</i>	111
Microcontroller-based Management System of Supercapacitor-aided Vehicle Starter <i>Aurel Cornel Stanca, Florin Sandu</i>	115
Monitoring Capacity System for Rechargeable Li-Ion Batteries <i>Dan Lozneanu, Ioan-Răzvan Lozneanu</i>	120
Practical Implementation of an Embedded Intelligent Control System <i>Sándor Tihamér Brassai, Levente Gidró, László Bakó, Géza Csernák</i>	125
Hardware Implemented Neural Network Based Mobile Robot Control <i>Sándor Tihamér Brassai, László P. Márton, László Dávid, László Bakó</i>	130
Software Instruments for Investigating Convolutional Encoding and Decoding Processes Applied in Communication Systems <i>Adriana Borodichieva</i>	135
Software Tool for Implementing Encryption and Decryption Processes Using Playfair Cipher <i>Adriana Borodichieva, Plamen Manoilov</i>	140
Review on Problems of Tin Whiskers after RoHS Changes <i>Barbara Horvath</i>	145
Pulsed Stress Behavior of IIF Resistors <i>D. Bonfert, H. Wolf, H. Gieser, G. Klink, K. Bock, P. Svasta, C. Ionescu</i>	150
Dynamic Tester for 3D Optical Data Storage System <i>M. Davidescu, V. Vulpe, E. Pavel, V. Cocoru, P. Svasta</i>	156
Test Methods for Gaussian Laser Beam Characterization <i>P. Schiopu, I. Cristea, N. Grosu, A. Craciun</i>	159
Platform for Digital Control of Processes Using Mega AVR Development Board <i>Ioan Lita, Daniel Alexandru Visan, Ion Bogdan Cioc</i>	164
The Advantages of Bluetooth Technology for Data Acquisition Systems <i>Daniel Alexandru Visan, Ioan Lita</i>	169
Data Acquisition Systems Based on GSM/GPRS Communications <i>Ion Bogdan Cioc, Ioan Lita, Daniel Alexandru Visan</i>	173
MM2C (Modelica-Matlab-to-C) Conversion Tool Analysis <i>Dorel Aiordachioaie, Viorel Nicolau, Anisia Gogu, Gabriel Sirbu</i>	179
Microwave Shields Using Metamaterials <i>Gheorghe Gavriloaia, Emil Sofron, Teodora Stefan cel Mare, Radu Fumarel</i>	184
Acceleration Sensor Used for Thoracic Movement Analysis <i>Adrian-Virgil Crăciun, Dávid Borzási</i>	188
Electrical Characterization of Electroluminescent Structures <i>Ciprian Ionescu, Detlef Bonfert, Paul Svasta</i>	193
The Measurement Methods for Variable Resistors Using Minimal Hardware and Software <i>L. Viman, S. Lungu, M. Dabacan</i>	198
An analysis of crosstalk on parallel PCB traces terminated on non-linear elements <i>Monica Zolog, Dan Pitică</i>	202
Design Technologies for Thermal Installations using Thermo-Electrical Analogies <i>Lucian Man, Eugeniu Man</i>	208

Energy Efficient ECG Signal Acquisition Channel for Ambulatory Patient's Monitoring <i>Ana Maria Pușcaș, Paul Borza, Marius Carp, Gheorghe Pand</i>	212
Smart Development Platform For Embedded Systems <i>Marius Carp, Ana Maria Pușcaș, Paul Borza</i>	217
Patient Remote Monitoring of Biophysical and Biochemical Signals <i>Paul Nicolae Borza, Ana-Maria Pușcaș, Marius Carp, Adrian Stavăr</i>	222
Energy Management System Based on Supercapacitors Used for Starting of Internal Combustion Engines of LDH1250 Locomotives and Charging their Batteries <i>Paul Nicolae Borza, Marius Carp, Ana Maria Pușcaș, Iuliu Szekeley, George Nicolae</i>	227
Pulse Oximetry, a Method of Monitoring Heart Disease Patients <i>Adrian Stavăr, Paul Borza, Marius Carp, Ana Maria Pușcaș</i>	232
High Accuracy Multi-Channel Digital Potentiometer <i>Marius Rangu, Catalin Negrea</i>	237
Using of Abort-on-first-fail in the Test Process of Hybrid BIST <i>Ilie Popa</i>	241
Construction and First Experimental Results of a Wireless Fetal Pulse Oximeter <i>Ákos Becker, Norbert Stubbán, Gábor Harsányi</i>	247
About the Electrical Resistivity of Some Finemet Alloys in Microwave Range <i>Daniela Ionescu, Iulia Brîndușa Ciobanu</i>	253
The Processing and Identification of the Mobile Information <i>Alexandru Vasile, E. Carpus, Paul Svasta, I. Ignat, Andrei Drumea Adina Tapu, Georgiana Dumitru</i>	258
On the Maximum Specific Stored Energy of Supercapacitors <i>Vasile V.N. Obreja, Ciprian Ionescu, Alexandru Vasile, Paul Svasta, Dumitru Scheianu, Marian Raduciu, Emil Sofron</i>	263
Fillers Used in Electrically Conductive Adhesives – A Short Review of the State of the Art <i>Pavel Mach, Radoslav Radev</i>	267
Theoretical and Experimental Background of Resistance and Nonlinearity Measurements of Adhesive Conductive Joints <i>Pavel Mach, David Bušek</i>	272
Driving QVGA and WQVGA LCD Panels with 30fps Live Video Stream using HS USB <i>Géza Csernák, Barna Csenteri, Attila Asztalos, Tihamér Brassai, Iuliu Szekeley</i>	276
Location Based Services based on Cell Identification <i>Dan Mihail Curpen</i>	281
Automatic Optical Inspection (AOI) of PCB using GPGPU <i>Alexandru Suciu, István Lorentz, Robert Lázár</i>	286
Data Acquisition System for Audio Frequency Echo Detection <i>Attila Buchman, Serban Lungu, Stefan Oniga, Alin Tisan</i>	291
Intelligent Biometric Access Control System with Environment Monitoring <i>Csaba-Zoltán Kertész, Petre Ogrușan, Iuliu Szekeley</i>	296
Investigating the Shear Strength of Chip Component Solder Joints <i>Oliver Krammer, Zsolt Illyefalvi-Vitéz</i>	301
Examination of Low-Temperature Sintered Joints of Large Area Semiconductor Devices <i>Réka Bátorfi, Zsolt Illyefalvi-Vitéz</i>	306
Lead-free Laboratory Platform for Engineering Skills Development in the Field of Ecological Electronic Packaging <i>Radu Bunea, Norocel Codreanu, Cristian Fărcaș, Paul Svasta</i>	311
Development of a low Cost CNC Equipment using Ecological Electronics <i>Iulian Oancea, Ioan Plotog, Norocel Codreanu</i>	315

The Reflow Soldering Thermal Profile and Consequences over Functionality of Lead-Free Solder Joints <i>I. Plotog, G. Varzaru, T.C. Cucu, P. Svasta, C. Turcu</i>	319
Temperature and Relative Humidity Controller Developed Around of a PIC18F458 Microcontroller <i>Cristian Fărcaș, Dan Pitică, Dorin Petreus, Ionuț Ciocan and Alin Grama</i>	324
Digital Technology in Power Systems – Achieving More Than Power <i>Gabriel Chindris, Dan Pitica, Marius Muresan</i>	328
Laser Pulsed Stress Behavior of HF Resistors <i>D. Bonfert, H. Wolf, H. Gieser, G. Klink, K. Bock, P. Svasta, C. Ionescu</i>	333
Automatic System for Distance Sensor Scaling <i>Septimiu Pop, Dan Pitica, Ioan Ciascai</i>	338
2D Measurement System with Image Sensor <i>Ioan Ciascai, Septimiu Pop, Ioan Lucian</i>	341
Experimental and Numerical Analysis of Mechanical Behavior of Multilayer PWB Assemblies <i>Bálint Sinkovics, Olivér Krammer, László Jakab</i>	345
EuroTraining develops the Nanoelectronics Training Roadmap <i>Zsolt Illyefalvi-Vitéz, Hervé Fanet</i>	350
E-Learning Training System For Electronics Assembling Technology <i>Zsolt Illyefalvi-Vitéz, Paul Svasta, Norocel Codreanu, Alena Pietrikova</i>	356
Permittivity Resonance Determinations for the Light Valves with Black Ceramic Pigment <i>Daniela Ionescu, Vlad Cehan</i>	361
Program Implementation for Study of Beta Radiation Interactions with Substance in E-Learning Environment <i>Iulia Brîndușa Ciobanu, Daniela Ionescu</i>	366
Knowledge Quiz in Macromedia Flash for Study of Physics in Electronics Engineering <i>Iulia Brîndușa Ciobanu, Daniela Ionescu</i>	371
Lumped-Parameter Computer Model of the Cardiac Prosthesis <i>Grigore Tinica, Liviu Amariei, Doina Butcovan</i>	376
Transvalvular Comparative Studies of the Artificial Heart Valves <i>Grigore Tinica, Liviu Amariei, Doina Butcovan</i>	379
Qualifying Lead-Free Solder Joints on Printed Circuits Boards <i>Bálint Károly Medgyes</i>	385
Intelligent Sensors for Remote Monitoring of Parameters in Distribution Points of District Utilities for Heat and Water <i>Andrei Drumea, Ioana Ilie, Paul Svasta, Alexandru Vasile</i>	389
Analysis of Influences to Reflow Quality by Variation of Material and Reflow Parameters <i>Heinz Wohlrabe</i>	393

Author Index

A. Bokor, 70	Florin Sandu, 89, 115
A. Craciun, 159	G. Varzaru, 319
Adina Tapu, 258	G. Klink, 150, 333
Adrian Mailat, 1, 16	Gábor Harsányi, 247
Adrian Nedelcu, 89	Gabriel Chindris, 328
Adrian Stavăr, 222, 232	Gabriel Sirbu, 179
Adriana Borodzhieva, 135, 140	George Lojewski, 46
Adrian-Virgil Crăciun, 188	George Nicolae, 1, 227
Ákos Becker, 247	Georgiana Dumitru, 258
Alena Pietriková, 85, 111, 356	Géza Csemáth, 125, 276
Alexandru Suciu, 286	Gheorghe Gavriloiu, 184
Alexandru Vasile, 258, 263, 389	Gheorghe Morariu, 6, 89
Alin Grama, 31, 50, 55, 324	Gheorghe Pană, 11, 212
Alin Tisan, 291	Grigore Tinica, 376, 379
Ana Maria Pușcaș, 212, 217, 227, 232, 222	H. Gieser, 150, 333
Andrei Drumea, 258, 389	H. Wolf, 150, 333
Anisia Gogu, 179	Heinz Wohlrabe, 393
Attila Asztalos, 276	Helmut Koeberl, 36
Attila Buchman, 291	Hervé Fanet, 350
Aurel Cornel Stanca, 115	I. Cristea, 159
Balázs Illés, 60, 65	I. Ignat, 258
Bálint Károly Medgyes, 385	I. Petrescu, 70
Bálint Sinkovics, 345	Iaroslav-Andrei Hapenciuc, 94
Barbara Horvath, 145	Ileana Damian, 80
Barna Csenteri, 276	Ilie Popa, 241
C. Turcu, 319	Ioan Ciascai, 338, 341
Carmen Gerigan, 16	Ioan Lita, 164, 169, 173
Catalin Negrea, 26, 237	Ioan Plotog, 315, 319
Ciprian Ionescu, 150, 193, 263, 333	Ioana Ilie, 389
Constantin Branescu, 80	Ioan-Răzvan Lozneanu, 120
Cristian Damian, 80	Ion Bogdan Cioc, 164, 173
Cristian Fărcaș, 311, 324	Ionuț Ciocan
Csaba-Zoltán Kertész, 296	Ionuț Ciocan, 324
Damien Boissat, 36	Ionuț Ciocan, 50, 55
Dan Lozneanu, 120	Ioan Lucian, 341
Dan Mihail Curpen, 281	István Lorentz, 286
Dan Pitică, 202, 324, 328, 338	Iulia Brîndușa Ciobanu, 253, 366, 371
Dan Tudor Vuza, 36, 41	Iulian Chereches, 101
Daniel Alexandru Visan, 164, 169, 173	Iulian Oancea, 315
Daniela Ionescu, 253, 361, 366, 371	Iuliu Szekely, 89, 227, 276, 296
Dávid Borzsi, 188	Jan Urbančík, 85, 111
David Bušek, 272	Juraj Durisin, 85
Detlef Bonfert, 150, 193, 333	K. Bock, 150, 333
Doina Butcovan, 376, 379	L. Viman, 198
Dorel Aiordachioaie, 179	László Bakó, 125, 130
Dorin Petreus, 31, 50, 55, 324	László Dávid, 130
Dumitru Scheianu, 263	László F. Márton, 130
E. Carpus, 258	László Jakab, 345
E. Pavel, 156	Levente Hidró, 125
Emil Plaian, 31	Lia-Elena Aciu, 11, 21
Emil Sofron, 184, 263	Liviu Amariei, 376, 379
Eugeniu Man, 208	Lucian Man, 208
F. Todor, 70	M. Dabacan, 198

Energy Efficient ECG Signal Acquisition Channel for Ambulatory Patient's Monitoring

Ana Maria Pușcaș, Paul Borza, Marius Carp, Gheorghe Pană

Department of Electronics and Computers, "Transilvania" University of Brașov, 500024, Brașov, Romania,
+40268-478705, FAX +40 268 410525 ana_maria.puscas@yahoo.com, borzapn@unitbv.ro,
marius.carp@yahoo.com, pana@vega.unitbv.ro

Abstract

Heart diseases and infarct dead are major problems that need to be assessed as often as possible in the modern society. Performing these assessments in ambulatory conditions would be a huge advantage. Unfortunately, the present studies about acquiring ECG signals and interpreting them in an ambulatory dynamic context is not very well known yet and that's why we have designed an IIIrd class protection ECG (Electrocardiograph) system able to be correlated with multiple biophysical and biochemical parameters acquired from the patient.

The present paper describes an ECG system designed to respect the functional and non-functional characteristics and thus, the ECG system has to be reliable, scalable, available and maintainable. Our major goal was to obtain a wearable ECG system with low power consumption that can be fully embedded in a complex remote monitoring system with low cost and reduced power consumption.

The system has the possibility to alarm the patient if the acquired signal is different from the pattern stored in the local memory. This alarm can be sent to the patient's Personal Digital Assistant (PDA) as a result of doctor's interpretation or as a result of local processing of the acquired data and thus, we have eliminated the risk of dangerous situations.

The main goal presented in this paper is the architectural concept, the system's supply and the power management.

1. INTRODUCTION

Medical devices became more and more important in the health care field and they have been represented by very sophisticated devices that can save the patient's life.

The biggest problem in ambulatory monitoring is the electrocardiogram (ECG) which represents a graphical test that records the electrical activity (action biopotentials) of the heart. [1]

A typical ECG signal is represented in Fig. 1.

The appearance of the semiconductor technology has reduced the costs and the dimensions of the electrocardiographs and thus the ECG devices can be placed on the back side of a SmartPhone able to process the medical information and to send/receive alerts to/from a medic.

We have implemented an ECG device in accordance with American Heart Association's recommendations (AHA). The ECG system assures low cost, IIIrd class of patient protection in accordance

with EN 60601-2-25/1995 standard, energy management and wireless transmission of the acquired medical data.

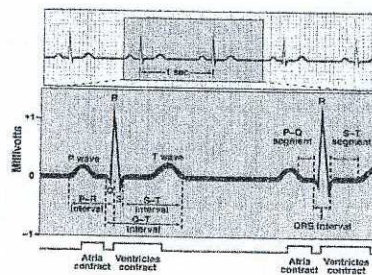


Fig. 1 ECG Signal [2]

2. STRUCTURE

Our solution for ECG ambulatory monitoring system is represented in Fig. 2 and it consists of an instrumentation amplifier, a band pass filter, an analog to digital converter, a reference and a pre-processing system.

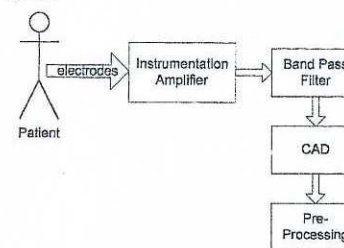


Fig. 2 The system's architecture

The instrumentation amplifier eliminates the common mode noises and amplifies the useful acquired ECG signal.

The band pass filter was designed in accordance with AHA's specifications that recommend the bandwidth between 0.03 Hz and 157 Hz in order to improve the quality of the acquired signal.

3. DESIGN

Some of the biggest problems are the common mode noises and the artifacts due to the patient's movement.

The influence of the common mode noise is shown in Fig. 3 and this problem was solved by using the instrumentation amplifier specially designed for medical applications.

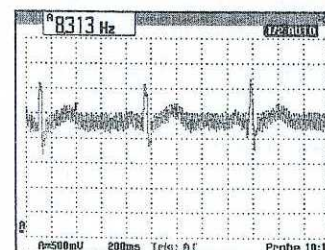


Fig. 3 The ECG signal influenced by the common mode noise

The artifacts that appear due to the patient's movement presented in Fig. 4 are eliminated by correlating them with the mechanical signal obtained from an accelerometer sensor placed on the patient's sternum.

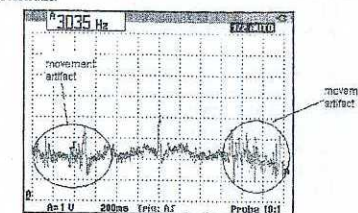


Fig. 4 The ECG signal influenced by the patient's movement

4. SIMULATION

Before being implemented, the system was simulated in PSpice. Some of the problems like the necessity of using dual supply for assuring supplementary electrostatic discharges protection were eliminated.

For example, by using a single supply for the instrumentation amplifier the diodes used as a protection for electrostatic discharges limit the ECG waveform as it is shown in Fig. 5. [3].

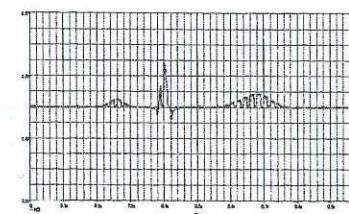


Fig. 5 QRS Complex

Thus the necessity of dual supply was assessed and the results presented in Fig. 6 were obtained.

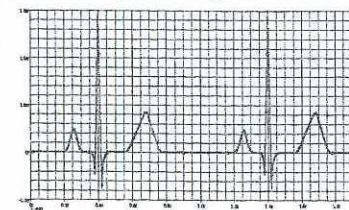


Fig. 6 QRS Complex

5. IMPLEMENTATION AND EXPERIMENTAL RESULTS

Because this system was designed for ambulatory monitoring some of the most important considerations are choosing the right power supply, assuring the protection of the patient and of the whole system at electrostatic discharges and implementing a good power management.

Because the ECG device is space-constrained and power-constrained we have used highly integrated analog components with low power consumption and adjustable gain amplifiers to condition and convert the signals into the digital domain so they can be processed and interpreted. [4]

There are 3 protection classes for medical devices [5]:

1. **Class 1 of protection** denotes an equipment in which protection against electric shock does not rely on basic insulation only, but which includes an additional safety precaution such that means are provided for the connection of accessible conductive parts to the protective (earthing) conductor in the fixed wiring installation so that accessible conductive parts cannot become live in the event of a failure of the basic insulation.
2. **Class 2 of protection** - the device denotes an equipment in which protection against electric shock does not rely on basic insulation only, but which includes additional safety precautions such as double insulation or reinforced insulation, there being no provision for protective earthing or reliance upon installation conditions.
3. **Class 3 of protection** - the device denotes an equipment in which protection against electric shock relies upon supply from SELV (Separated Extra Low Voltage) circuit in which hazardous voltages are not generated (extracts from BS EN 60950: 1992).

Being implemented wearable, the ECG system was designed to use as power supply batteries. By choosing components that work at low voltages the necessity of using DC-DC converters was eliminated and thus the power consumption was reduced too. Replacing the power supplies with the batteries we placed our device in IIIrd class of medical device protection and thus the medical standards have been respected.

The acquired signal from the patient by the help of the implemented device is shown in Fig. 7.

The ECG module has the possibility to preprocess the information and to send the medical information to another module for advanced processing. Thus, a Matlab advanced processing is shown in the Fig. 8.

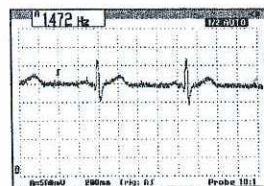


Fig. 7 ECG acquired signal [6]

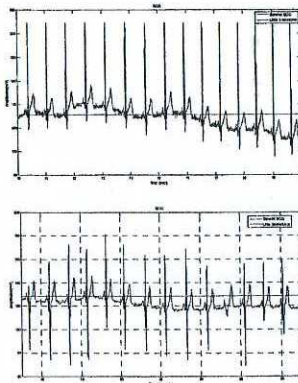


Fig. 8 ECG processed in Matlab

6. ENERGY MANAGEMENT

6.1. Batteries and power supplies

Because a wearable system has to use as power supply small batteries, available power is limited and thus for the ECG system all the components were chosen to assure minimum power consumption. [7]

Simulating the system, the optimal supply levels were established. At the beginning a DC-DC converter was used to assure the differential supply but the noises that the DC-DC converter has introduced and the big amount of energy consumption have determined us to eliminate it. Eliminating this component the power consumption was reduced from 90mA/3.7V to 10mA/3.7V and the spikes produced by the converter disappeared too.

Because the components use different levels of power supplies we have used 2 batteries to assure the differential power supply and for adjusting the voltage levels we have used reference components with low power consumption. Thus, the ECG system has 150

hours autonomy if the system is supplied at 1500mAh batteries.

6.2. Segmentation

All of these wearable medical devices need a low-power microcontroller or/and a software solution for energy management implemented onto the microcontroller. [4]. Because this device was designed to run on batteries, an important goal is lengthening the battery's life.

The ECG system was designed to work on three different situations: *daily monitoring* (normal situation)-when the patient has a stable status or "normal status"-, *alerts* -when the monitored parameters exceeds the normal threshold of the parameters correlated with the other monitored parameters- and *emergency* -a status that requires medical intervention.

Because of the three working situations described above, in order to improve the patient's vital signs evaluation and to reduce the power consumption for each situation a monitoring schedule was implemented as it is represented in Fig. 9.

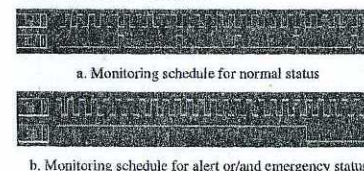


Fig. 9 Time schedule for ECG monitoring (on the abscise axis time is given in minutes 1 cycle = 4 minutes)

At every 20 minutes the ECG makes a 2 minutes recording. By making this schedule the energy management is improved and the power consumption is reduced to less than 1mA/3.7V. This means that the ECG acquisition system has 1500h autonomy by using a 1500mAh battery.

An alternative to reduce the power consumption is to use a microcontroller that can parallel process the medical information. Thus, in combination with vector processing, parallel processing reduces the power consumption and is suitable for medical applications. Also, a software technique that partitions the processing algorithm into a number of blocks that can operate in parallel at reduced clock frequency can be implemented and thus it results a higher rate signal processing path and a reduced rate control. [7]

6.3. System's power consumption

The power consumption for the signal-processing component of the wearable medical application can typically be split into the signal conversion/conditioning and the signal processing. The power consumed by the signal conversion is

largely determined by the signal-to-noise ratio (SNR) and bandwidth required (sampling rate). [7]

The ECG signal is pre-processed by the help of a microcontroller based module. Because the ECG system was designed to be wearable and to be used in ambulatory monitoring, a Bluetooth solution was implemented for sending the medical information from the acquisition system to the PDA. The whole testing system is presented in Fig. 10.

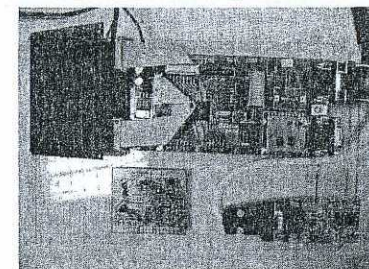


Fig. 10 The testing ECG system

By adding the Bluetooth module the power consumption was increased from 10mA/3.7V to 40 mA/3.7V. The power consumption of the processing unit programmed in Normal Mode is 40mA/3.7V and programmed in Standby Mode is less than 80µA/3.7V. Thus, the testing system has 80mA/3.7V power consumption in Normal Mode. By respecting the schedule presented before, in emergency situations the system has 18 hours autonomy and in normal situations the whole system has 185.64 hours autonomy.

7. CONCLUSIONS

Portable medical equipment is improving healthcare for millions of patients and products like heart rate monitors have enhanced the quality of life for those with chronic or acute diseases and conditions. [4]

Medical devices data management systems became a necessity for healthcare because of the continuously increasing complexity of the devices.

We have focused our research on the energetic aspects because this represents a major feature related to the portable and wearable devices. A significant problem was finding the optimal components and chemical power supplies in order to reduce the power consumption and to assure long time availability of the device. A good power management was described too.

This paper presents an optimal ECG architecture as well. A wearable ECG system was designed and

implemented in compliance with the BS EN 60601-2-25/1995 medical standard of patient's protection and a dynamic software (scheduling) solution was also described in order to reduce the power consumption.

The successfully distribution of the medical information via a Bluetooth channel with low power consumption increases the self confidence of the patient. A wire communication solution increases the sampling rate and reduces the power consumption and this is adequate for wearable devices.

The whole context of this article is a part of the national project BIOMED-TEL currently under development at the "Transilvania" University of Brasov - Department of Electronics and Computers [8].

REFERENCES

- [1] Paul Borza, Ioan Matlac, *Aparatură Biomedicală*, Ed Tehnica, Bucuresti, 1996
- [2] http://courses.bio.psu.edu/Spr2003/141_901/EKG/ECG.html

- [3] Ana-Maria Puscas, Gheorghe Pană, „Simularea Spice a unui Sistem Electronic de Monitorizare a Activității Inimii”, „AFASES - 2008”, 16 - 17 Mai 2008, Braşov, Romania, ISBN: 978-973-8415-56-0
- [4] Kevin Balnap, „SoC microcontrollers power portable medical device innovation”, Texas Instruments, 01.08. 2008
- [5] David Holland, Jimmy Tziimenakis, *Electrical Product Safety: A Step-by-Step Guide to LVD Self Assessment signing for safety*
- [6] Ana Maria Puscas, Paul Borza, Doru Talabă, „Tele-Monitoring System for Biophysical and Biochemical Parameters in Ambulatory Treatment”, “2008 IEEE International Conference on Automation, Quality and Testing, Robotics AQTR 2008 - THETA 16th edition -”, May 22-25 2008, Cluj-Napoca, Romania, ISBN: 978-973-713-248-2
- [7] Todd Schneider, Dave Hermann, “Portable medical apps challenge low-power quest”, Courtesy of EE Times, 28.07.2008
- [8] *** Project “BIOMED TEL” D11-057, PNII 4, 2007
- [9] http://www.ael.utcluj.ro/ORGANIZARE/GABRIEL%20CHINDRIS/CURSURI%20ELECTRONICA%20MEDICALA/cur s_2.pdf
- [10] www.analog.com

Smart Development Platform For Embedded Systems

Marius Carp, Ana Maria Puscas, Paul Borza

Department of Electronics and Computers, “Transilvania” University of Braşov, 500024, Braşov, Romania,
Tel: +40268-478705, Fax: +40 268 410525

marius.carp@yahoo.com, ana_maria.puscas@yahoo.com, borzapn@unitbv.ro

Abstract

Nowadays, a platform for testing development systems became more and more important being assessed by the technological evolution and the wide range of the applications. This is the reason that has determined us to design a multi purpose development platform for general use in embedded systems suitable for real time signal acquisition, real time signal processing and also, for data storage, data analysis and data transmission. Even if the platform approach offers a large number of benefits it was designed with low non recurring engineering costs and low manufacturing costs and thus, the platform is suitable for testing and for implementing as well.

The development platform has already proved to be very useful in medical, energy, automotive and e-learning applications but the biggest advantage is that it offers the possibility for wireless transmission/receiving data to/from many acquisition systems, to store data, to concentrate and to locally process an interpret them.

Embedded system applications require architectures based on microcontrollers combined with I/O components in order to achieve computation and communication performances.

The possibility to execute distributed tasks and to correlate the results increases the range of applications for the development platform.

1. INTRODUCTION

Nowadays, embedded system's field became a necessity.

We focused our research on developing a Smart Platform with low cost and low power consumption able to be used in a variety of applications like data acquisition and data mining, health care field, automotive, energy applications, learning and e-learning.

This platform is based on AVR8 family, a new generation of 8-bits microcontrollers that includes on the same chip a very powerful interrupt control system.

These controllers have in the same time a low power consumption that recommends this family for portable and/or energy intensive applications. For this reason we have adopted these controllers to implement our Smart Platform (SP).

In this paper are presented several applications in the field of portable medical devices, energy power management and automotive.

2. TECHNOLOGICAL RESEARCH AND ARCHITECTURE

Before implementing the Smart Platform studies about the components behavior were made. A prototype platform was implemented and each module was tested by designing the component's drivers.

We have analyzed a lot of microcontroller's families and we have taken into account the following elements: (i) processability of the CPU represented by ISA, internal architecture and clock performance; (ii) the possibilities to communicate: so-called communication interfaces (serial and parallel ports), converters analog to digital (A/D) and digital to analog (D/A), including the interrupt system.

For these reasons we have chosen AVR8-bits family that also has very low consumption accepting to be supplied between 2.7 to 5V and presents a sophisticated power management on chip (6 different modes) and also a good ratio performance/price. Thus, the system is suitable for portable applications.

The architecture of the prototype is presented in Fig. 1.