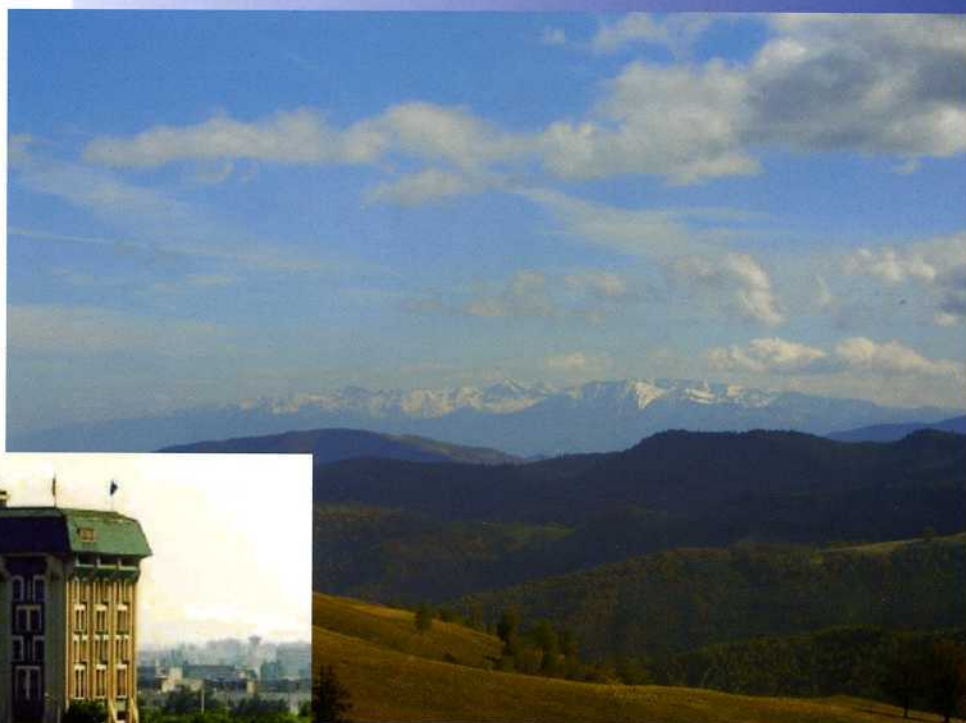


September 18-21, Predeal, ROMÂNIA

SIITME 2008

Conference proceedings



International Symposium
for Design and Technology
of Electronic Packaging

14th Edition, Predeal, România
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TRANSILVANIA University of Brasov



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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 Ogrujan, Gheorghe Morariu</i>	6
A Model for Electromagnetic Shielding Evaluation Applied to Nanomaterials <i>Petre Ogrujan, Lia-Elena Aciu, Gheorghe Pana</i>	11
Microcontroller Based Embedded System for Unconventional Power Source Management <i>Adrian Mailat, Petre Ogrujan, Carmen Gerigan, Peter Gal</i>	16
Overview on Shielding Effectiveness Measurement Methods for Conductive Materials <i>Lia-Elena Aciu, Petre Ogrujan, 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 III-V 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 Borzsi</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 Bátori, 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 Eletronics 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 Hapenciu, 94
Barbara Horvath, 145	Ileana Damian, 80
Barna Csenter, 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

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].

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Smart Development Platform For Embedded Systems

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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.



Because it is a general purpose platform an important problem was how to choose the right components and how to make good power management hardware and software as well.

3. IMPLEMENTATION

The implemented Smart Platform is presented in Fig. 2.



One of the biggest problems was to separate the analog and digital components. Thus, we have designed two separated ground planes for the above mentioned signals (analog and digital). The analog ground plane connects all the passive components presented in Fig. 2 and the digital one it is dedicated to the microcontroller. The analog and digital ground planes were connected on the microcontroller's analogical ground PIN in order to eliminate the digital noises generated by the commutation of the processor. Because the ADC (Analog to Digital Converter) PORT is very susceptible to noises the datasheet specification were respected and the system was implemented in order to have the length of the nets as short as possible.

Experimental results have proved that the features of the ATMega128 have satisfied all the needs for our applications related to the medical ambulatory.

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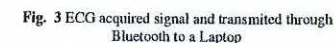
An important aspect is the supplying system. To improve the energy management all the components have separately ways for supplying and thus if the supplying battery reaches a threshold voltage value all the peripheral components are disabled and the Smart Platform automatically saves the context and enters in Power Down Mode.

4. APPLICATIONS AND EXPERIMENTAL RESULTS

The Smart Platform was designed to be supplied from chemical and also from non-chemical power supplies. Thus the Platform is suitable for wearable applications that need low power consumption, research, educational applications and for industrial electrical power applications too.

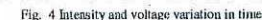
4.1. Health care field

A Bluetooth solution was implemented with LMX9838 and the digitized medical data were sent to a Laptop/PDA (Personal Digital Assistant) that supplementary processed and pointed the data out onto a graphical display as it is shown in Fig. 3. [2]



4.2. Energy applications

An experimental result of this application it is presented in Fig. 4. [3]



Another important application is storing the acquired data. Thus, a software solution was implemented and the stored parameters from the MMC Card helped at making historical evolution diagrams for the locomotive.

4.3. Automotive

By the help of this Platform studies about fuel consumption, average speed, engine RPM (rotation

per minute), temperature, oxygen sensor voltage, air flow rate and maintenance can be made.

A general result of these offline studies it is represented by a historical table of the monitored parameters and a graphic.

The vehicle's data logger is presented in Fig. 5.

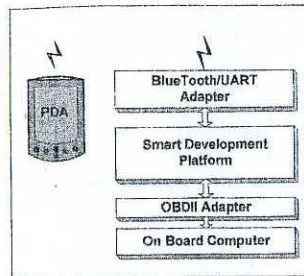


Fig. 5 Vehicle's data logger

We have detailed a part of the automotive application Fig. 6.

4.4. Learning and e-learning

Because the hardware and firmware were designed in order to fulfill the didactical needs, the Smart Platform is a versatile system that can be used for workshops in the field of electronics. Thus, the system reaches the requirements of a learning object that can be used as a didactical material for possible applications.

To be suitable for the field of electronics learning we have previewed the system with the capacity of storing the acquired data onto the local card. The acquired signals, once they are digitized they can be wirelessly sent to other processing modules or they can be sent via SMS to a phone/PDA. Also, graphics can be made and pointed out onto the local display attached to the Smart Platform.

The AVR family architecture is one of the preferred architectures being suitable for educational and experimental purposes because of its wide range of supported applications.

We have used ATmega128 that has FLASH, EEPROM and SRAM memories, auxiliary units such as counters, timers, memory, pulse-width modulation units, RTC clocks, A/D converters etc and these modules are mandatory in the improvement of the student's skills. [3]

All the facilities of the Platform can be used in remote laboratory too and thus the importance of the platform is increased.

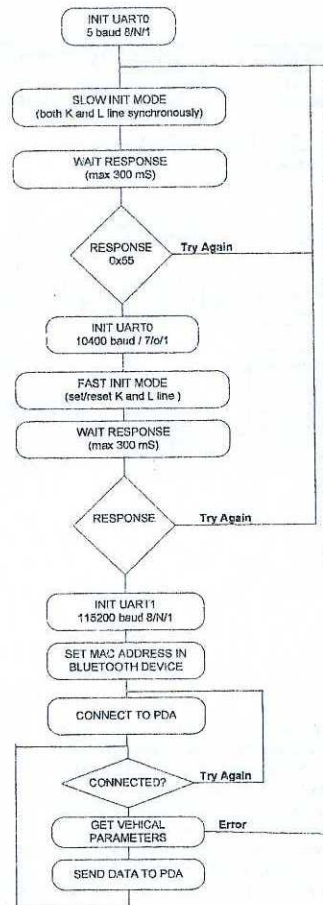


Fig. 6 Flow diagram of vehicle's data logger

The system can generate a sequence for a mirror system in order to excite it and after that to collect its outputs sequences (hardware test bench).

5. CONCLUSIONS

In this paper, a new general purpose Development Platform for embedded systems was described.

The platform was designed to have low power consumption and thus to be suitable for a wide area of applications.

Being designed with low non recurring costs the platform has proved to be suitable for applications such as electronics, computer engineering, chemistry, physics, probability and statistics, medicine, automatics, automotive, robotics etc. [4]

Because e-learning environment education needs to be integrated partly or completely into education we have adapted this Smart Platform to be used in remote laboratory.

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