

IT'15
ŽABLJAK

XX

međunarodni naučno - stručni skup

**INFORMACIONE
TEHNOLOGIJE**

SADAŠNJOST I BUDUĆNOST

Urednik
Božo Krstajić

IT'15

**INFORMACIONE
TEHNOLOGIJE**

- SADAŠNJOST I BUDUĆNOST -

Urednik
Božo Krstajić

*Zbornik radova sa XX međunarodnog naučno - stručnog skupa
INFORMACIONE TEHNOLOGIJE - sadašnjost i budućnost
održanog na Žabljaku od 23. do 28. februara 2015. godine*

Zbornik radova
INFORMACIONE TEHNOLOGIJE - sadašnjost i budućnost 2015

Glavni urednik
Prof.dr Božo Krstajić

Izdavač
Univerzitet Crne Gore
Elektrotehnički fakultet
Džordža Vašingtona bb., Podgorica
www.etf.ucg.ac.me

Tehnička obrada
Aleksandra Radulović
Centar Informatičnog Sistema
Univerziteta Crne Gore

Tiraž
150

Podgorica 2015.

Sva prava zadržava izdavač i autori

Organizator

Elektrotehnički fakultet, Univerzitet Crne Gore

Suorganizatori:

Elektrotehnički fakultet, Univerzitet u Beogradu

Elektrotehnički fakultet, Univerzitet u Banja Luci

Elektronski fakultet, Univerzitet u Nišu

Fakultet tehničkih nauka, Univerzitet u Novom Sadu

Skup su podržali:

Ministarstvo za informaciono društvo i telekomunikacije

Agencija za elektronske komunikacije i poštansku djelatnost

doMEn d.o.o.

Terna Crna Gora

Pošta Crne Gore

Programski odbor

Dr Novak Jauković, Elektrotehnički fakultet, Podgorica, MNE
Dr Ljubiša Stanković, Elektrotehnički fakultet, Podgorica, MNE
Dr Zdravko Uskoković, Elektrotehnički fakultet, Podgorica, MNE
Dr Vujica Lazović, Ekonomski fakultet, Podgorica, MNE
Dr Branko Kovačević, Elektrotehnički fakultet, Beograd, SRB
Dr Milorad Božić, Elektrotehnički fakultet, Banja Luka, BIH
Dr Miroslav Bojović, Elektrotehnički fakultet, Beograd, SRB
Dr Zoran Jovanović, Elektrotehnički fakultet, Beograd, SRB
Dr Milica Pejanović-Đurišić, Elektrotehnički fakultet, Podgorica, MNE
Dr Despina Anastasiadou, Research & Development Innovation Academy, Solun, GRC
Dr Dejan Popović, Elektrotehnički fakultet, Beograd, SRB
Dr Gabriel Neagu, National Institute for Research & Development in Informatics, Bucharest, ROU
Dr Božo Krstajić, Elektrotehnički fakultet, Podgorica, MNE
Dr Tomo Popović, Texas A&M Univerzitet, College Station, TX, USA
Dr Milovan Radulović, Elektrotehnički fakultet, Podgorica, MNE
Dr Le Xie, Texas A&M University, College Station, TX, USA
Dr Sašo Gelev, Elektrotehnički fakultet, Radoviš, MKD
Dr Budimir Lutovac, Elektrotehnički fakultet, Podgorica, MNE
Dr Igor Radusinović, Elektrotehnički fakultet, Podgorica, MNE
Dr Alex Sprintson, Texas A&M University, College Station, TX, USA
Dr Igor Đurović, Elektrotehnički fakultet, Podgorica, MNE
Dr Miloš Daković, Elektrotehnički fakultet, Podgorica, MNE
Dr Milutin Radonjić, Elektrotehnički fakultet, Podgorica, MNE
Dr Ana Jovanović, Elektrotehnički fakultet, Podgorica, MNE
Dr Vesna Rubežić, Elektrotehnički fakultet, Podgorica, MNE
Dr Ramo Šendelj, Fakultet za Informacione Tehnologije, Podgorica, MNE
Dr Stevan Šćepanović, Prirodno-matematički fakultet, Podgorica, MNE

Organizacioni odbor

Dr Novak Jauković, Elektrotehnički fakultet, Podgorica
Dr Božo Krstajić, Elektrotehnički fakultet, Podgorica / CIS UCG
Dr Milovan Radulović, Elektrotehnički fakultet, Podgorica
Dr Zoran Veljović, Elektrotehnički fakultet, Podgorica
Dr Ana Jovanović, Elektrotehnički fakultet, Podgorica
Dr Saša Mujović, Elektrotehnički fakultet, Podgorica
MSc Žarko Zečević, Elektrotehnički fakultet, Podgorica
Vladan Tabaš, dipl.ing., Čikom, Podgorica

Sekretarijat

Aleksandra Radulović, CIS Univerzitet Crne Gore

P R E D G O V O R

Poštovani učesnici i čitaoci,

Pred vama je jubilarni XX zbornik radova međunarodnog naučno-stručnog skupa "INFORMACIONE TEHNOLOGIJE – sadašnjost i budućnost" (IT'15) koji je uspješno održan od 23. do 28. februara 2015. godine na Žabljaku. Programski odbor je izvršio selekciju kvalitetnih radova koji su pred vama, a najbolji među njima će biti prošireni i objavljeni u časopisu Elektrotehničkog fakulteta Univerziteta Crne Gore u Podgorici ("ETF Journal of Electrical Engineering").

Ovakav jubilej i jubilarni Zbornik je prilika da se osvrnemo i na misiju ove konferencije, na neke univerzalne vrijednosti koje smo zadržali, a i na inovacije koje smo uveli. U proteklih 20 godina IT je prepoznat kao relevantna, nekad nacionalni, sada međunarodni naučno stručni skup koji se trudio i trudi da omogući širokom spektru naučnika i stručnjaka prezentaciju, kako rezultate naučnih istraživanja i trendova, tako i uspješnih stručnih projekata i rješenja. Nijesmo se nikad ograničavali samo na ICT, već smo ostavljali prostor za sve oblasti nauke i djelatnosti u kojima se primjenjuje ICT, a teško je danas naći izuzetke. Trudili smo se da se na IT-u pojavljuju najeminentniji naučnici i stručnjaci, ali i mladi istraživači, inženjeri, a zadnje dvije godine i studenti. Uveli smo i neke nove prakse kao posledice primjene tehnologija koje promoviramo: elektronsku obradu korespondencije sa autorima, elektronski proces recenzije, objavljivanja radova na sajtu, katalogizaciju istih te online praćenje i prezentovanje radova. Proširili smo djelatnost konferencije sa učešćem kompanija i institucija sa uspješnim projektima, a posebno smo ponosni i na studentsko učešće. Ove godine smo posvetili čitav segment samo studentima i pripremili posebna predavanja i prezentacije za njih. Konačno i tradicionalno, vjerovatno jedan od značajnih argumenata za učešće na IT-u je neponovljiva priroda Durmitora, gostoprimstvo grada i poslovnično nezaboravna druženja učesnika.

Ovdje je svakako mjesto da se pomenu i rodonačelnici ovog skupa, koji su prije 20 godina započeli ovu konferenciju: prof. dr Novak Jauković, prof. dr Srbijanka Turajlić, prof. dr Dejan Popović i prof. dr Srđan Stanković, i čije je aktivno učešće u radu jubilarnog skupa potvrda da isti ima kontinuitet, kredibilitet i budućnost.

Sve detalje o ovom, prošlim i narednom skupu možete naći na web adresi konferencije www.it.ac.me.

Prof. dr Božo Krstajić

SADRŽAJ

Dejan Popović, Lana Popović Maneski (<i>Rad po pozivu</i>) ROBOTIKA U REHABILITACIJI: EGZOSKELETI I PROTEZE ZA GORNJE EKSTREMITETE ROBOTICS FOR REHABILITATION: EXOSKELETONS AND PROSTHESES FOR UPPER LIMBS... 1	
Tomo Popović NAPREDNE TEHNIKE U PYTHON-U: DEKORATORI ADVANCED PYTHON TECHNIQUES: DECORATORS 7	7
Žarko Zečević, Zdravko Uskoković, Božo Krstajić NOVI ALGORITAM ZA ESTIMACIJU FAZORA U ELEKTROENERGETSKIM SISTEMIMA A NEW ALGORITHM FOR PHASOR ESTIMATION OF POWER SYSTEMS..... 11	11
Vladana Mrdak, Božo Krstajić PRIMJER IMPLEMENTACIJE RJEŠENJA ZA BACKUP I RESTORE PODATAKA AN IMPLEMENTATION EXAMPLE OF BACKUP AND RESTORE SOLUTION 15	15
Marija Blagojević, Maja Božović, Zoran Jevremović, Miloš Papić ANALIZA OBRAZACA PONAŠANJA KORISNIKA RAZLIČITIH STILOVA UČENJA U OKVIRU KOLABORATIVNIH MODULA ANALYSIS OF USERS' BEHAVIOUR PATTERNS OF STUDENTS WITH DIFFERENT LEARNING STYLES WITHIN THE COLLABORATION MODULES 19	19
Bogdan Mirković PRIKAZIVANJE ONTOLOGIJA U MIKS-METODSKIM ISTRAŽIVANJIMA MEĐUORGANIZACIONIH INFORMACIONIH SISTEMA PRESENTING ONTOLOGY IN MIXED METHOD RESEARCH OF INTERORGANIZATIONAL INFORMATION SYSTEMS..... 23	23
Bogdan Mirković INTEGRACIJA METODOLOGIJA U RAZVOJU SOFTVERA ZA PODRŠKU INFORMACIONOM SISTEMU INTEGRATION OF METHODOLOGY IN SOFTWARE DEVELOPMENT FOR SUPPORTING INFORMATION SYSTEM..... 27	27
Jelena Šoškić, Budimir Lutovac IMPLEMENTACIJA PROGRAMSKOG PAKETA WIPL-D ZA PRORAČUN PRILAGOĐENJA SA JEDNIM REAKTIVNIM ELEMENTOM IMPLEMENTATION OF THE WIPL-D PROGRAM PACKAGE FOR SINGLE STUB MATCHING.... 31	31
Luka Lazović, Ana Jovanović, Vesna Rubežić IMPLEMENTACIJA TEORIJE HAOSA U OPTIMIZACIJI LMS ALGORITMA PRIMJENJENOG NA LINEARNIM ANTENSKIM NIZOVIMA IMPLEMENTATION OF CHAOTIC BASED OPTIMIZATION OF LMS ALGORITHM APPLIED ON LINEAR ANTENNA ARRAYS..... 35	35
Sanja Bauk, Radoje Džankić O IZAZOVIMA PRIMJENE RFID TEHNOLOGIJE U LANCIMA SNABDIJEVANJA UPON CHALLENGES OF RFID TECHNOLOGY IMPLEMENTATION IN SUPPLY CHAINS 39	39

Novica Daković, Milovan Radulović FLATNESS I LQR UPRAVLJANJE FURUTA KLATNOM FLATNESS AND LQR CONTROL OF FURUTA PENDULUM	43
Tomislav B. Šekara, Milovan Radulović NOVA METODA ZA OPTIMIZACIJU PID REGULATORA ZASNOVANA NA PRINCIPU NESIMETRIČNOG OPTIMUMA A NOVEL METHOD FOR OPTIMIZATION OF PID REGULATORS BASED NON-SYMMETRICAL OPTIMUM METHOD	47
Vasilija Šarac PRIMENA SIMULINKA U SIMULACIJI ELEKTRIČNIH MAŠINA APPLICATION OF SIMULINK IN SIMULATION OF ELECTRICAL MACHINES	52
Vasilija Šarac IMPLEMENTACIJA SCADA SISTEMA U HIDORELEKTRANI “KOZJAK” IMPLEMENTATION OF SCADA SYSTEM IN HPP “KOZJAK”	56
Aleksandar Ristić, Dalibor Damjanović KRITIČKA ANALIZA UPOTREBE MEDIJA U OBRAZOVANJU NA UNIVERZITETU OREGON SA OSVRTOM NA MOGUĆU PRIMJENU PRIMJERA DOBRE PRAKSE NA UNIVERZITETIMA U REPUBLICI SRPSKOJ CRITICAL ANALYSIS OF THE USE OF MEDIA IN EDUCATION AT THE UNIVERSITY OF OREGON, WITH A REVIEW OF POSSIBLE IMPLEMENTATION OF GOOD PRACTICE AT UNIVERSITIES IN REPUBLIC OF SRPSKA	60
Edin Salković DIGITALIZACIJA PEDOLOŠKIH PODATAKA CRNE GORE DIGITAZING THE PEDOLOGIC DATA OF MONTENEGRO	64
Aleksandar Dedić JEDAN METOD MJERENJA NAPONA I STRUJE BAZIRAN NA MIKROKONTROLERU A MICROCONTROLLER BASED VOLTAGE AND CURRENT MEASUREMENT METHOD	68
Duško Parezanović, Dragan Vidaković KAKO SE POTPISUJE PORUKA HOW TO SIGN THE MESSAGE	72
Radiša Stefanović, Aleksa Srdanov NESPECIFICIRANI USLOVI U IMPLEMENTACIJI ALGORITAMA PRI REŠAVANJU LOGIČKIH ZADATAKA UNSPECIFIED CONDITIONS IN THE IMPLEMENTATION OF ALGORITHMS IN SOLVING LOGICAL PROBLEMS	76
Matija Ratković, Slavica Tomović, Nikola Žarić, Milutin Radonjić, Igor Radusinović EMULACIJA SDN MREŽA SOFTVERSKIM ALATOM MININET SDN NETWORK EMULATION WITH MININET SOFTWARE TOOL	80
Slavica Tomović, Milutin Radonjić, Milica Pejanović-Đurišić, Igor Radusinović SOFTVERSKI DEFINISANE BEŽIČNE SENZORSKE MREŽE SOFTWARE DEFINED WIRELESS SENSOR NETWORKS	84

Jelena Šuh, Branislav Sisojević INFORMACIONO-KOMUNIKACIONI ALATI ZA UPRAVLJANJE IP/MPLS MREŽOM INFORMATION-COMMUNICATION TOOLS FOR IP/MPLS NETWORK MANAGEMENT	88
Blažo Popović, Ranko Vojinović ANALIZA WIFI MREŽA U URBANOM DIJELU PRIJESTONICE ANALYSIS OF WIFI NETWORKS IN URBAN PART OF OLD ROYAL CAPITAL	92
Veselin N. Ivanović, Nevena Radović, Srdjan Jovanovski, Zdravko Uskoković UNAPRIJEDJENA PROCEDURA ZA ESTIMACIJU LOKALNE FREKVENCije VISOKO NESTACIONARNIH DVO-DIMENZIONALNIH FM SIGNALA AN IMPROVED PROCEDURE FOR THE LOCAL FREQUENCY ESTIMATION OF HIGHLY NONSTATIONARY TWO-DIMENSIONAL FM SIGNALS.....	96
Mirza Mulešković NIVO RAZVIJENOSTI IKT U CRNOJ GORI I E-SERVISA ZA PREDUZEĆA LEVEL OF DEVELOPMENT OF ICT IN MONTENEGRO AND E-SERVICES FOR COMPANIES ..	100
Milan Marić, Duško Pavićević, Maja Medenica ONLINE UPARIVANJE VISOKOG OBRAZOVANJA I TRŽIŠTA RADA U CRNOJ GORI ONLINE MATCHING HIGHER EDUCATION AND LABOUR MARKET IN MONTENEGRO.....	104
Aleksandar Milenković, Dragan Janković PRIMENA MEDICINSKIH INFORMACIONIH SISTEMA U REPUBLICI SRBIJI – TRENUTNO STANJE I MOGUĆA UNAPREĐENJA APPLICATION OF MEDICAL INFORMATION SYSTEMS IN THE REPUBLIC OF SERBIA – CURRENT STATUS AND POSSIBLE IMPROVEMENTS	108
Obradović Milovan PODRŠKA ICT PRAĆENJU I MERENJU ZADOVOLJSTVA KORISNIKA ZDRAVSTVENE ZAŠTITE ICT SUPPORT TO MONITORING AND HEALTHCARE USERS SATISFACTION MEASUREMENT	112
Jelena Končar, Sonja Leković PRIMENA B2C ELEKTRONSKOG PLAĆANJA U REPUBLICI SRBIJI IMPLEMENTATION OF B2C ELECTRONIC PAYMENT IN REPUBLIC OF SERBIA	116
Zoran Milivojević, Zoran Veličković, Bojan Princević INHARMONIČNOST KONTRA OKTAVE STEINWAY B KLAVIRA INHARMONICITY OF CONTRA OCTAVE OF THE PIANO STEINWAY B.....	120
Milesa Srećković, Magdalena Dragović, Aleksandar Čučaković, Biljana Đokić Milošević, Nada Ratković Kovačević DIZAJN, SIMULACIJA I MODELOVANJE U INŽENJERSTVU U OKVIRU IZABRANIH PROBLEMATIKA DESIGN, SIMULATION AND MODELING IN ENGINEERING WITHIN SELECTED PROBLEMS.....	124
Mirko Kosanović, Miloš Kosanović ENERGETSKI PROFIL POTROŠNJE ENERGIJE U SENZORSKOM ČVORU ENERGY PROFILE OF ENERGY CONSUMPTION IN SENSOR NODE	128

Nataša Savić, Zoran Milivojević, Vidoje Moračanin ANALIZA EFIKASNOSTI POLYA RACIONALNOG PARAMETARSKOG INTERPOLACIONOG JEZGARA KOD PROCENE FUNDAMENTALNE FREKVENCije ANALYSIS OF EFFICIENCY OF POLYA RATIONAL PARAMETRIC INTERPOLATION KERNEL IN THE ESTIMATION OF FUNDAMENTAL FREQUENCY	132
Zoran Veličković, Zoran Milivojević, Miloško Jevtović PRIMENA ITERATIVNOG ALGORITMA ZA POPRAVKU KVALITETA EKSTRAHOVANOG VODENOG ŽIGA IZ VIDEA STRIMOVANOG U BEŽIČNOM OKRUŽENJU APPLICATION OF ITERATIVE ALGORITHM FOR ENHANCEMENT OF EXTRACTED WATERMARK FROM THE VIDEO STREAMED IN A WIRELESS ENVIRONMENT	136
Martin Čalasan, Vladan Vujičić, Gojko Joksimović, Nikola Šoć, Chen Hao PREGLED MATEMATIČKIH MODELA MORSKIH STRUJA REVIEW OF MARINE CURRENT MATHEMATICAL MODELS	140
Risto Bojović, Ivana Milošević, Hristina Bojović ULOGA MODELA SPIRALNE DINAMIKE U RAZVOJU IT SISTEMA THE ROLE OF SPIRAL DYNAMICS MODEL IN IT SYSTEMS DEVELOPMENT	144
Maja Kukuševa Paneva, Biljana Čitkuševa Dimitrovska, Goce Stefanov PREGLED INTEGRISANE ŠEME PO ELIPTIČKOJ KIRIVULJI OVERVIEW OF ELLIPTIC CURVE INTEGRATED SCHEME.....	148
Ana Grbović, Bojan Đordan PCS7 VREMENSKA SINHRONIZACIJA U HE PERUĆICA PCS7 TIME SYNHRONIZATION IN HPP PERUĆICA	152
Tomče Velkov, Ace Panev, Roman Golubovski, Sašo Gelev, Vlatko Čingoski, Goce Stefanov, Maja Kukuseva Paneva SISTEM ZA KONTROLU AMBIJENTA U STAKLENIKU AMBIENT CONTROL SYSTEM IN GREENHOUSE.....	156
Slavica Kostadinova, Vlatko Čingoski, Roman Golubovski, Sašo Gelev POVEĆANJE ENERGETSKE EFIKASNOSTI VODOVODNIH SISTEMA POBOLJŠANJEM FAKTORA SNAGE PUMPNIH POSTROJENJA INCREASING ENERGY EFFICIENCY OF WATER SUPPLY SYSTEMS WITH PUMP SYSTEMS POWER FACTOR IMPROVEMENT.....	160
Goran Klepov, Vlatko Čingoski, Roman Golubovski, Sašo Gelev, Goce Stefanov NOVI METOD UPRAVLJANJA ASINHRONIH MOTORA SA INTERMITIRANIM REŽIMOM RADA U NAPAJANJU ARTISTIČKIH (MUZIČKIH) FONTANA A NEW CONTROL METHOD FOR INDUCTION MOTORS IN INTERMITTED WORKING REGIME FOR ARTISTIC (MUSIC-DRIVEN) FOUNTAINS	164
Goce Stefanov, Sašo Gelev, Vlatko Čingoski, Vasilija Šarac, Roman Golubovski ODREĐIVANJE IZLAZNIH KARAKTERISTIKA KVAZI-REZONANTNOG KONVERTORA POMOĆU KOMPJUTERSKIH SIMULACIJA DETERMINATION OF OUTPUT CHARACTERISTICS OF QUASI-RESONANT POWER CONVERTER WITH COMPUTER SIMULATION.....	168

Temelkovski Ordan, Sašo Gelev, Roman Golubovski, Vlatko Čingoski, Goce Stefanov PRIMENA FAZI LOGIKE U SISTEMU UPRAVLJANJA TOPLOTNIM PODSTANICAMA APPLICATION OF FUZZY LOGIC IN CONTROL SYSTEMS ARE HEAT SUBSTATIONS	172
Blažo Popović, Srđan Jovanovski PREGLED 6LOWPAN STANDARDA ZA POVEZIVANJE IOT OVERVIEW OF 6LOWPAN STANDARD FOR CONNECTING IOT	176
Mirko Jovović, Budimir Bukilić MOBILNI OPERATIVNI SISTEMI I BEZBJEDNOST. KAKO SE ZAŠTITITI? MOBILE OPERATING SYSTEMS AND SECURITY. HOW TO PROTECT YOURSELF?	180
Bogdan Krivokapić, Uglješa Urošević, Zoran Veljović, Milica Pejanović-Đurišić OPORTUNISTIČKI PRISTUP SPEKTRU U KOGNITIVNIM RADIO MREŽAMA OPPORTUNISTIC SPECTRUM ACCESS IN COGNITIVE RADIO NETWORKS	184
Branko Džakula DINAMIČKO TESTIRANJE I ANALIZA KLIJET-SERVER KOMUNIKACIJE U ANDROID APLIKACIJAMA DYNAMIC SECURITY TESTING AND ANALYSIS OF CLIENT-SERVER COMMUNICATION IN ANDROID APPLICATIONS	188
Stefan Vujović, Miloš Brajović, Slobodan Đukanović UPOTREBA WEB I MOBILNIH APLIKACIJA U AGRİKULTURI WEB AND MOBILE APPLICATIONS IN AGRICULTURE	192
Branko Džakula, Slobodan Đukanović REVERZNI INŽENJERING I METODE ZAŠTITE ANDROID APLIKACIJA REVERSE ENGINEERING AND ANDROID APPLICATION SECURITY	196
Bojan Domazetović, Enis Kočan POBOLJŠANJE ENERGETSKE EFIKASNOSTI BEŽIČNIH SENZORSKIH MREŽA KROZ KOOPERATIVNO PROSLJEĐIVANJE ENERGY EFFICIENCY IMPROVEMENT OF WIRELESS SENSOR NETWORKS THROUGH COOPERATIVE RELAYING	200
Stevan Šandi, Tomo Popović, Božo Krstajić IMPLEMENTACIJA IEEE C37.118 KOMUNIKACIONOG PROTOKOLA U PYTHON-U PYTHON IMPLEMENTATION OF IEEE C37.118 COMMUNICATION PROTOCOL	204
Miloš Brajović, Ljubiša Stanković, Miloš Daković REKONSTRUKCIJA NESTACIONARNIH SIGNALA SA NEDOSTAJUĆIM ODBIRCIMA PRIMJENOM S-METODA I GRADIJENTNOG ALGORITMA ZA REKONSTRUKCIJU RECONSTRUCTION OF NON-STATIONARY SIGNALS WITH MISSING SAMPLES USING S-METHOD AND A GRADIENT BASED RECONSTRUCTION ALGORITHM	208
Igor Ognjanović, Ramo Šendelj, Ivana Ognjanović PISMENOST U OBLASTI SAJBER BEZBJEDNOSTI U CRNOJ GORI CYBER SECURITY AWARENESS IN MONTENEGRO	212

Jelena Ljucović, Ivana Ognjanović, Ramo Šendelj ANALIZA OBRAZOVNOG SISTEMA U OBLASTI SAJBER BEZBJEDNOSTI U CRNOJ GORI ANALYSES OF CYBER SECURITY EDUCATIONAL SYSTEM IN MONTENEGRO	216
Tripo Matijević, Snežana Šćepanović, Marija Radojičić, Ivan Obradović, Saša Tatar RAZVOJ OKRUŽENJA ZA SPAJANJE AKADEMSKOG I PREDUZETNIČKOG ZNANJA PRIMJENOM OTVORENIH OBRAZOVNIH RESURSA CREATING ENVIROMENT FOR BLENDING ACADEMIC AND ENTREPRENEURIAL KNOWLEDGE USING OPEN EDUCATIONAL RESOURCES.....	220
Dejan Tomović, Ramo Šendelj, Ivana Ognjanović DOS I DDOS NAPADI I NJIHOVE KONTRAMJERE DOS AND DDOS ATTACKS AND THEIR COUNTERMEASURES	224
Aleksandar Rašović KORPORATIVNO UPRAVLJANJE INFORMATIKOM ICT GOVERNANCE.....	228
Biljana Stamatović, Armin Alibašić IZBOR I PRIKAZIVANJE PODATAKA IZ XML BAZA PODATAKA SELECTING AND REPORTING DATA FROM XML DATABASE	232

SISTEM ZA KONTROLU AMBIJENTA U STAKLENIKU AMBIENT CONTROL SYSTEM IN GREENHOUSE

Tomče Velkov, Ace Panev, Roman Golubovski, Sašo Gelev, Vlatko Čingoski, Goce Stefanov, Maja Kukuseva Paneva
Faculty of Electrical Engineering, UGD - Stip, R.Macedonia

Sadržaj: *Za postizanje dobrog rasta useva zasadenih u staklenik, neophodno je iskoristiti sva znanja o tome koje uslove moramo zadovoljiti da bi dobili očekivanu žetvu. Nekoliko klimatskih faktora su važni da bi se razvio održivi ambijent unutar staklenika, a to su temperatura, vlažnost vazduha, vlažnost zemljišta, cirkulacija vazduha kao i njihov međusobni odnos. Ovaj rad objašnjava kako se savremena tehnologija može iskoristiti u jednom automatizovanom računarskom sistemu za kontrolu stanja u unutrašnjosti staklenika, upotrebljavajući određeni hardver (senzore, aktuatore, embeded upravljač i personalni računar za SCADA interfejs). Prikazano rešenje upravlja klimatskim faktorima na efikasan način, koristeći asinhroni komunikaciski protocol između LabVIEW bazirane SCADA na host strani i C bazirane akvizicije podataka i pokrenuti sistem na embedded PIC platformi.*

Abstract: *In order to achieve a good growth of crops planted in a greenhouse, it is essential to implement the knowledge concerning specific conditions that need to be fulfilled to support expected harvest. In general several climate factors are important to be developed for sustainable ambient inside a greenhouse - temperature, air humidity, soil moisture, air circulation and also the relations between these factors. This paper depicts how contemporary technologies can be employed in an application of an automatic computerized system for controlling a stable environment inside a greenhouse, using affordable hardware (sensors, actuators, embedded controller and personal computer for SCADA interface). The presented solution controls the climate factors in an efficient way using an asynchronous communication protocol between a LabVIEW based SCADA on the host side, and a C based data acquisition and actuation system running on an embedded PIC platform.*

1. INTRODUCTION

Greenhouses Environment Control Systems form an important part of the agriculture and horticulture sectors in our country as they can be used to grow plants under controlled climatic conditions for optimal harvest (production). Appropriate environmental conditions are necessary to support plant growth, improved crop yields, and efficient use of water and other resources. The soil moisture, the air temperature and humidity govern the plant growth [1], [2].

Automating the control of the named three parameters ensures a reliable environment avoiding constant presence of human factor. The automation of the process variables relies on data acquisition for constant monitoring of all three with sufficient frequency compatible to the real dynamics of their fluctuations over time or in cases of abrupt disturbances, as well as on the proper actuation of the control variables having impact on the environment.

The technical focus of this article is a simple, yet powerful solution for achieving the goal using an affordable PIC based process controller, equipped with cheap sensors for monitoring temperature and humidity, as well as affordable laptop/desktop host PC running a "homemade" LabVIEW based user interface in a form of SCADA, that is used to set the control variables and perform all necessary processing, calculations and logging of important data.

2. THE CONCEPT

The concept of the working solution is given in figure 1.

The process controller is a PIC, equipped with analog and digital I/O. Through its multiplexed A/D converter it acquires three sensors for monitoring the corresponding process variables (PVs) - the air temperature and humidity, and the soil moisture.

The PIC packs and transmits the acquired data for asynchronous serial communication with the SCADA host. It also listens for commands from the host for actuation of the control variables (CVs).

Through the D/A converters the PIC controls a pump for water irrigation; a motor for opening/closing a window for air conditioning against the outside temperature and humidity; a heater for increasing the inside temperature; and a ventilator for air circulation when humidity regulation (in combination with the window) is needed.

The SCADA host receives the acquired PVs via RS232 serial link, presents them in their user interface (UI) gages and indicators, calculates commands for the actuators to modify/sustain appropriate values of the corresponding CVs, and transmits them via the serial link to the embedded PIC.

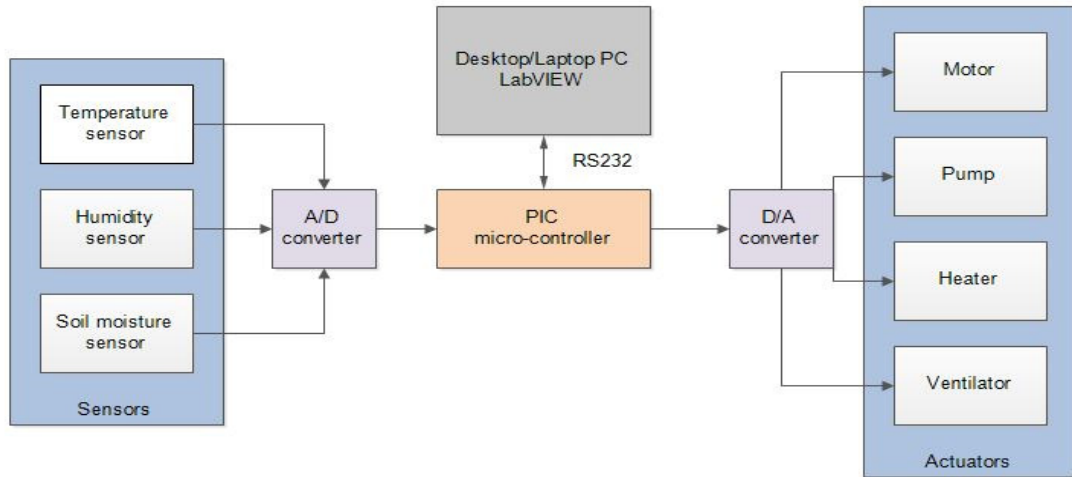


Figure 1: Block-diagram of the ambient control system in greenhouse

3. THE HARDWARE PLATFORM

The hardware platform organized around the embedded controller is given on figure 2.

The microprocessor is a low-cost 8-bit PIC16F877A equipped with 10-bit analog inputs multiplexed to a single ADC, digital I/O lines and an UART for serial communication.

The soil moisture sensor is SEN92355P, an affordable resistance based one (figure 3). The wetter the soil, the less resistive it is and the voltage transducer provides higher

output. Being an analog sensor, it is connected to the A/D converter via the pin RA0/AN0.

The air temperature & humidity transducer DHT11 is also a low-cost combination of a thermistor and a capacitive humidity sensor [3]. It has its own ADC and outputs digital signal for both measurements. It is therefore connected to the bi-directional DIO pin RD2/PSP2.

All of the actuators are controlled in a ON/OFF manner, so they are connected to the digital outputs RB7/PGD (the irrigation pump), RB5 (the window motor), RB4 (the airflow ventilator) and RB2 (the air heater).

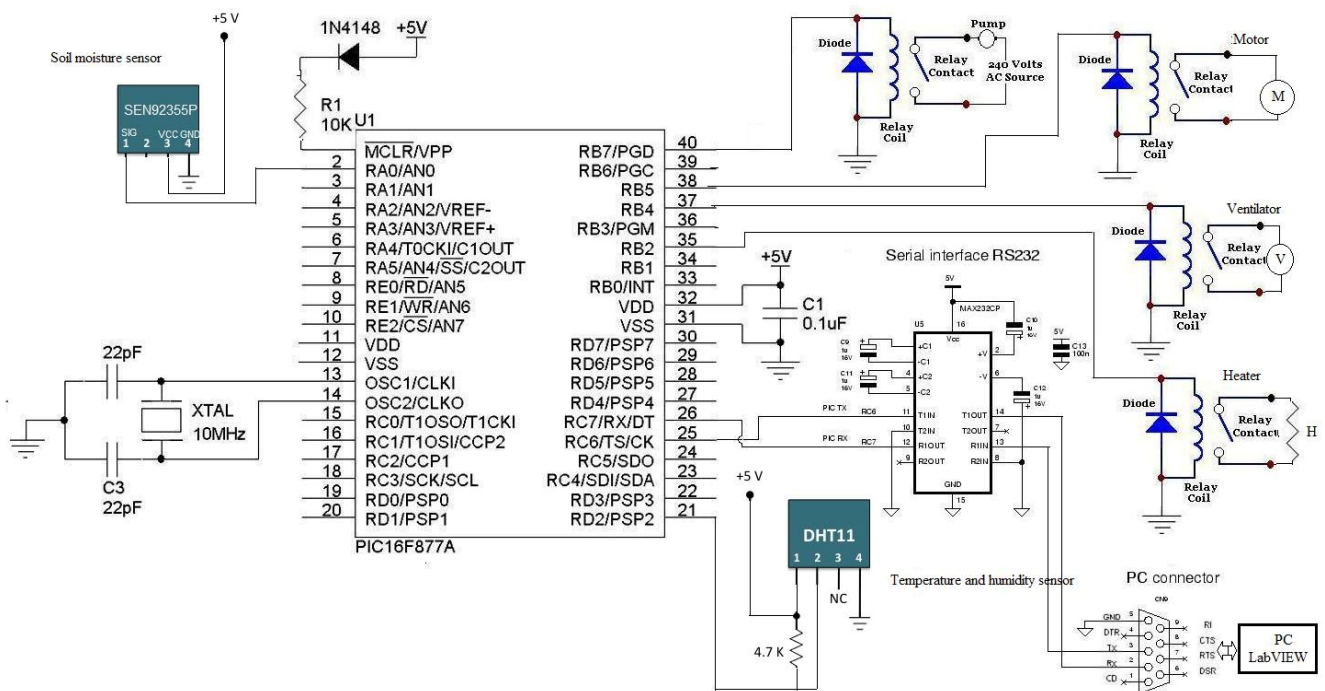


Figure 2: Circuit diagram of the ambient control system

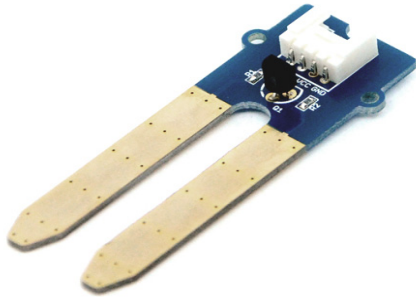


Figure 3: Soil moisture sensor (SEN92355P)

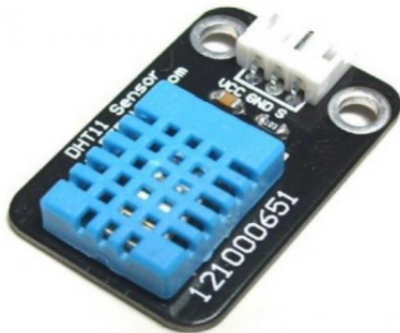


Figure 4: Temperature and humidity sensor (DHT11)

Understandable, all the digital outputs are conditioned toward the actuators via protective relays. The RS232 serial communication interface is realized with the MAX232 driver.

4. THE SOFTWARE SOLUTION

The SCADA concept based on an asynchronous serial communication protocol is given on figure 5.

It depicts the complete data loop formed by the on-field PIC based process controller and its supervising PC Host running the graphical user interface (GUI) of the SCADA.

The upper and lower parts of the block diagram show the C coded algorithm executing on the PIC. It performs continuous cyclic reading from and writing to the COM port. It reads the next ON/OFF statuses of the actuators, calculated by the process control algorithm on the Host. It writes the latest acquired values of the sensors for the Host to calculate next actuators' statuses.

The PIC executes as fast as possible. After receiving the new (ON/OFF) statuses for the actuators it immediately updates the corresponding digital outputs (DOs) with 1/0s accordingly.

After every read of the COM port buffer and update on its DOs it performs an acquisition of the current sensor values. The soil moisture sensor is acquired through its analog input (AI) in a form of 10bit integer (binary level representation), and the air temperature and humidity are read by a digital input (DI) to which their transducer is connected, in a form of two 8bit integers (one for each of the sensors).

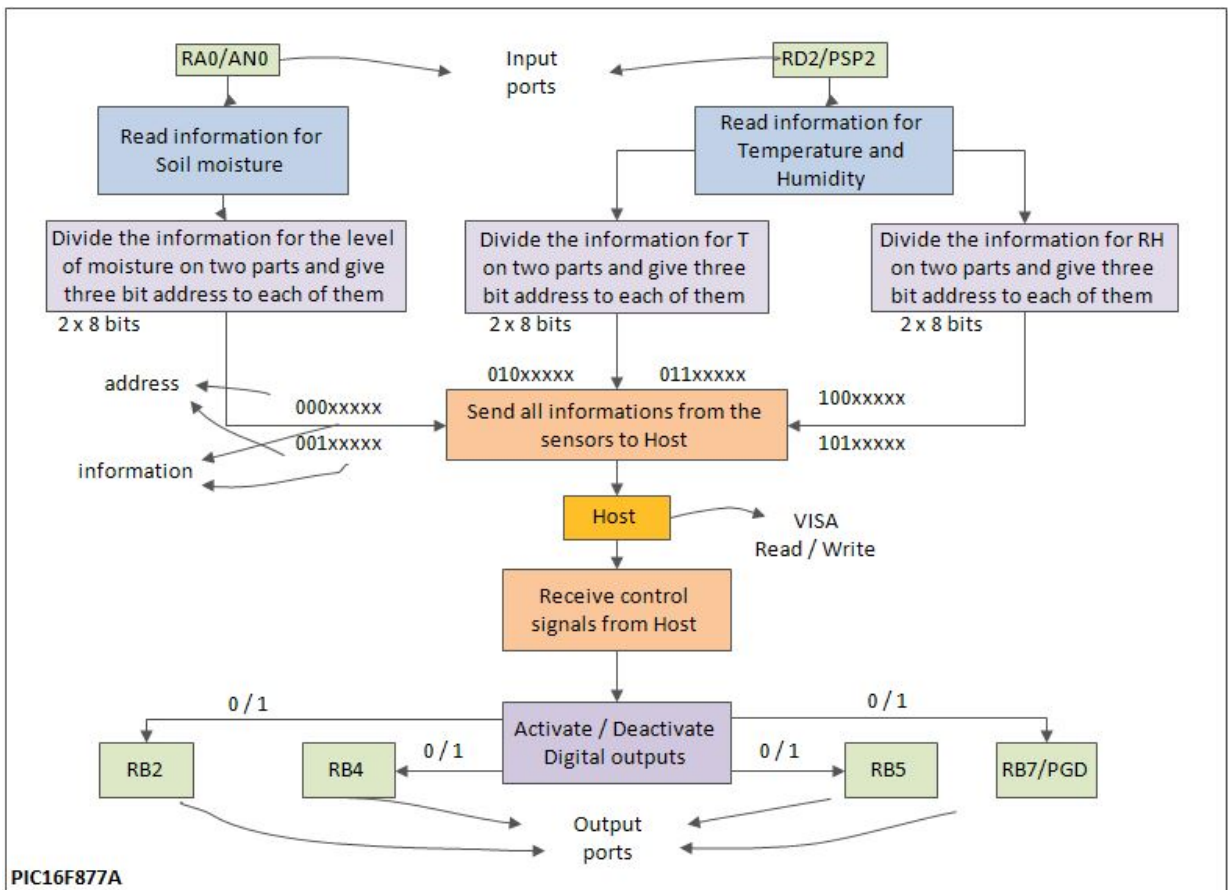


Figure 5: The SCADA concept

After all three sensors are read they are packed for sending to the Host. Due to the nature of the asynchronous protocol (no handshaking) the packing process assures the correct order for receiving on the Host side by the following framing scheme:

- divide the soil moisture 10bit integer into two halves
- frame the upper 5 bits with 000 in front into the MSB1 (00=1st sensor + 0=MSB)
- frame the lower 5 bits with 001 in front into the LSB1 (00=1st sensor + 1=LSB)
- divide the air temperature 8bit integer into 3+5 bits
- frame the upper 3 bits with 01000 in front into the MSB2 (01=2nd sensor + 0=MSB + 00 as data)
- frame the lower 5 bits with 011 in front into the LSB2 (01=2nd sensor + 1=LSB)
- frame the upper 3 bits with 10000 in front into the MSB3 (10=3rd sensor + 0=MSB + 00 as data)
- frame the lower 5 bits with 101 in front into the LSB3 (10=3rd sensor + 1=LSB)

After all data is packed for sending (string of 6 bytes), it is sent to the COM port FIFO buffer.

On the Host side the LabVIEW based control algorithm [4] constantly listens for incoming data on the COM port, whenever possible, while not processing sensors data and calculating next actuators statuses. The processing loop reads every incoming byte, looking at its first three bits, searching for the combination 000 (MSB1) and the next five bytes up to LSB3 (figure 6).

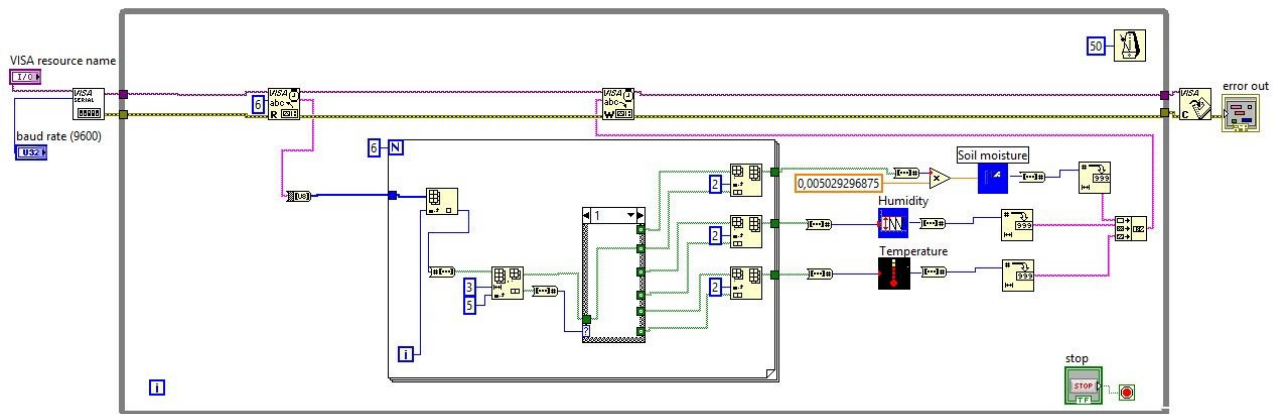


Figure 6: The main control loop coded in LabVIEW

After sensors data is consolidated it is used by SCADA's control algorithm to compare PVs values against the corresponding set points (SPs) and determine new statuses for each of the actuators, having in mind their hysteresis.

Figure 7 shows the GUI panel where the user/operator can adjust all the environmental set points that define the greenhouse ambient.

5. CONCLUSION

This paper is a prominent example of how modern technologies can easily and affordably be employed in-house

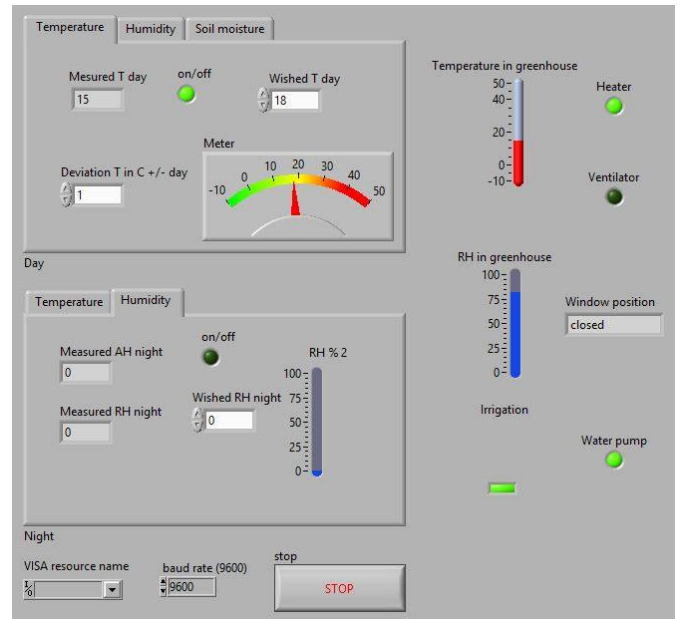


Figure 7: The SCADA GUI

for solving real life problems and challenges. It depicts a straight forward implementation of a simple SCADA for automated control of a greenhouse inside climate, using conventional strategy for process variables comparison to their respective set points, and actuating the control variables by the means of standard motors, heaters, irrigation pumps. It also employs some affordable electronics (the embedded PIC), and "proprietary" serial communication protocol between the PIC and the PC based Host.

Exploitation is expected to show increased productivity!

REFERENCES

[1] Peter Kamp, Gert Jan Timmerman, "Computerised Environmental Control in Greenhouses", a step by step approach, PTC+, The Netherlands, 2002
 [2] Y. Hashimoto, G.P.A. Bot, W. Day, H.-J. Tantau, H. Nonami, „The Computerized Greenhouse: Automatic Control Application in Plant Production”, February 1993
 [3] Jacob Fraden, „Nandbook of modern sensors:Physics, Designs and Applications”, September 2010
 [4] Jeffrey Travis, Jim Kring, „LabVIEW for everyone: Graphical programming made easy and fun”, Third edition, August 2006