ICCEREC

THE 2017 INTERNATIONAL CONFERENCE ON CONTROL, ELECTRONICS, RENEWABLE ENERGY, AND COMUNICATIONS

PROCEEDINGS

ISBN : 978-1-5386-1667-3

September 26-28, 2017
Tentrem Hotel, Yogyakarta-Indonesia

Telkom University

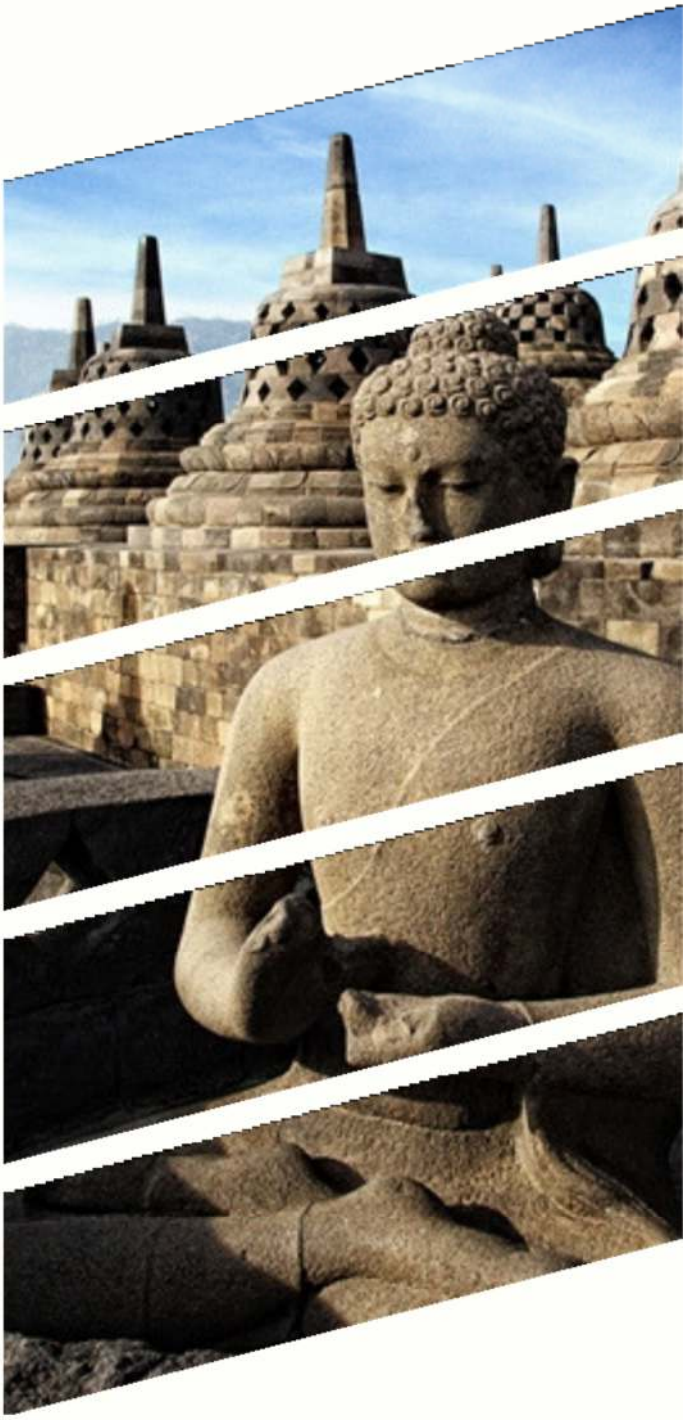
IEEE ComSoc IEEE Communications Society Indonesia Chapter

IEEE Signal Processing Society Indonesia Chapter

ABOUT
ICCEREC 2017

ICCEREC 2017 is organized by the international organizing committee of ICCEREC and is technical co-sponsored by the IEEE Communications Society Indonesia Chapter and IEEE Signal Processing Society Indonesia Chapter, so that ICCEREC has a strong foundation of bringing together industry and academia.

This conference provides an international forum for researchers, academicians, professionals, and students from various engineering fields and with cross-disciplinary interests in control, electronics, renewable energy, computer engineering and communications to interact and disseminate information on the latest developments. The conference will include technical sessions, tutorials, and technology and business panels. You are invited to submit papers in all areas mentioned above. Accepted papers will be published in the ICCEREC 2017 Conference Proceedings and presented papers will be submitted to IEEE Xplore after each paper is thoroughly reviewed and (if any) satisfactorily modified according to the reviewer comments.



WELCOME MESSAGE

GENERAL CHAIR OF ICCEREC 2017

SIGIT YUWONO, PhD

Welcome to ICCEREC 2017, Yogyakarta – Indonesia.
It is our great pleasure to welcome you to the International Conference on Control, Electronics, Renewable Energy, and Communications 2017 (ICCEREC 2017), which is already the 3rd running; while the 1st and the 2nd were held in Bandung in 2015 and 2016, respectively.

This conference provides an international forum for researchers, academicians, professionals, and students from various engineering fields and with cross-disciplinary interests in control, electronics, renewable energy, computer engineering and communications to interact and disseminate information on the latest developments.

Papers submitted to ICCEREC this year came from authors in North America, Europe, Africa, and Asia countries.
ICCEREC 2017 is organized by international technical program committee, organizing committee, and international steering committee, and is technical co-sponsored by the IEEE Communications Society Indonesia Chapter and the IEEE Signal Processing Society Indonesia Chapter.
In this occasion, I would like to express my sincere appreciation to all above contributors for their great help and valuable supports to ICCEREC 2017. Many thanks to them for their efforts to bring all attendees an excellent technical program and an opportunity to spend a pleasant time at the conference.
The committee expect that the conference will bring many benefits to the scientific and technological development and to new or established international collaborations. The committee is doing its best effort for the inclusion of the conference proceedings to the IEEE Xplore Data Base. So that, the presentations of this conference will be accessible to a wider range of readers and will have continual impact to this research field.
Yogyakarta is one of the oldest cities in Indonesia, so it is very historical and is considered as the foremost cultural center of Java; therefore, tourist attractions are easily found in Yogyakarta. I hope all attendees an enjoyable and memorable stay in Yogyakarta.

Yogyakarta, 26 September 2017

Chair of ICCEREC 2017,

Sigit Yuwono, PhD.
Telkom University

WELCOME MESSAGE

TPC CHAIR OF ICCEREC 2017

Dr. RINA PUDJI ASTUTI

Welcome to ICCEREC 2017,
It is a great honor for all of us to host of The third International Conference on Control, Electronics, Renewable Energy and Communications (ICCEREC) 2017 in Yogyakarta, Indonesia. Welcome to Yogyakarta and we hope that you enjoy the center of Javanese arts, graceful palace, the foods, and richness culture.

This conference represents a great achievement in topics of interest, which the best contributors coming from excellent laboratories and schools throughout the world, precipitate to come and contribute their finest works. Where the high qualified papers in Control, Electronics, Renewable Energy and Communicatios will be presented.

The conference received 141 papers with 350 authors from 20 countries. After carefully peer reviews by 138 reviewers, we have 68 accepted papers from 16 countries. And finally we have 50 registered papers from 10 countries. ICCEREC 2017 has maintain high quality technical program. We also would like to thank to SPS Indonesia Chapter and Telkom University as the organizer of 3rd ICCEREC 2017, and ComSoc Indonesia Chapter that involved as Technical Co-Sponsor of the conference. We hope that fruitful discussions and exchange of ideas between researchers during conference will yield new technological innovations for contributing to a better life for humans in the coming decades.

Best Regards,
TPC Chair of ICCEREC 2017

Dr. Rina Pudji Astuti

PROGRAM AT A GLANCE

Day One, 26 September 2017

- 08.00 - 08.30 Registration
- 08.30 - 09.30 Opening Ceremony
- 09.30 - 10.15 Keynote Session I
- 10.15 - 10.30 Coffee Break
- 10.30 - 11.15 Keynote Session II
- 11.15 - 12.00 Keynote Session III
- 11.00 - 13.00 Lunch
- 13.00 - 14.30 Technical Session 1 & 2
- 14.30 - 14.45 Coffee Break
- 14-45 - 16.30 Technical Session 3 & 4
- 19.30 - 21.00 Gala Dinner

Day Two, 27 September 2017

- 08.00 - 09.30 Tutorial 1 & Technical Session 5
- 09.30 - 09.45 Coffee Break
- 09.45 - 11:30 Tutorial 2 & Technical Session 6
- 11.30 - 13.00 Lunch
- 13.00 - 14.30 Technical Session 7 & 8

Day Three, 28 September 2017

- One Day Tour

KEYNOTE SESSION

Keynote Speech 1 :
26 September, 2017
09.30 - 10.15

Assoc Prof. Dr. Jiwa Abdullah

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING, UNIVERSITI TUN HUSSEIN ONN, MALAYSIA

"WSN/IOT INTEGRATION TOWARDS SEAMLESS CYBER- PHYSICAL SYSTEMS"

Abstract:

Before the 90s, monitoring system being deployed in isolation. Each application stands by its own. Vendors try to capture their proprietary product in the hope of making so much financial gain as possible. Nevertheless, in past two decades, a lot of research activities have been dedicated to the fields of mobile ad hoc network (MANET) and wireless sensor networks (WSN). Products are more universally deployed, from multiple vendors and are talking to each other. More integration are being done and deployed. Multiple platforms seems inevitable but with proper standardization, seamless operations are in place. More recently, the cyber- physical system (CPS) has emerged as a promising direction to enrich the interactions between physical and virtual worlds. In the presentation, we first review some research activities in MANET, WSN, IoT, including networking issues and coverage and deployment issues. Then, we review some CPS platforms and systems that have been developed recently, including health care, navigation, rescue, intelligent transportation, social networking, and gaming applications. Through these reviews, we hope to demonstrate how CPS applications exploit the physical information collected by WSNs to bridge real and cyber spaces and identify important research challenges related to CPS designs.

KEYNOTE SESSION

Keynote Speech 2 :
26 September 2017
10.30 - 11.15

Full Prof. Dr. Zoran Bojkovic

LSM IEEE UNIVERSITY OF BELGRADE,
REPUBLIC OFSERBIA

"CURRENT TECHNOLOGICAL ADVANCES TO SMART GRIDS"

Abstract:

A smart grid (SG) delivers electricity from suppliers to consumers using at the same time two-way digital technology that reduces cost and increases reliability and transparency. Here, communication networks play a critical role as the intelligence of this complex system is built based on information exchange across the power grid. An intelligent monitoring system that keeps track of all electricity flowing as well as the use of superconductive transmission lines for less power loss are included, too. Of course, the integration of alternative sources of electricity, such as solar and wind is welcome. These features help to promote energy independence and are a key tool in dealing with emergency resilience issues.It should be noted that the design of the communication network associated with the SG involves a detailed analysis of requirements, including choice of the most suitable technologies for each case study and the architecture for the resultant heterogeneous system. In this presentation, potential implications that current technological advances can make to SG are outlined firstly, such as big data, cloud computing and the Internet of Things (IoT). Data analysis generated from various smart devices in the SG environment, is one of the most challenging tasks as it varies with respect to parameters such as size, volume, velocity and variety. Another big challenge in building SG often arises from the fast growing amount of data and limited communication resources. To address this issues, the concept of distributing communications architecture that implements SG communications in an efficient and cost- effective manner is provided. In that way, communication distance is shortened, so that the data will be delivered more efficiently and reliably. With the rapid development of electric vehicles (EVs), the energy management issues in SGs integrated with Evs are attracting huge interest. This is a reason to tackle the corresponding issue. On the other hand, machine-to.machine communication is a significant part in SG networks.This improved automation results in a many heterogeneous applications. Thus, the final part is assigned to this goals. Finally,a number of open questions have been posed which will be of practical interest for further development of SGs and energy system as a whole. The end draws the conclusion of the presentation.

KEYNOTE SESSION

Keynote Speech 3 :
26 September 2017
11.15 - 12.00

Dr. Eng. Takayuki Nozaki
YAMAGUCHI UNIVERSITY

"INTRODUCTION AND RECENT RESULTS OF FOUNTAIN CODES"

Abstract:

The reliable communication systems can be realized by error/erasure correcting codes. Fountain codes are erasure correcting codes realizing the reliable communications system for the user diagram protocol (UDP), which is used in multicasting and broadcasting.
The first topic of this talk is fundamentals of fountain code. This introduces two well-known fountain codes, namely, LT code and Raptor code, and these decoding algorithms. Moreover, we briefly introduce some applications of the fountain code.
The second topic is recent results of fountain codes. We introduce a recent code construction based on bit-level shift, that is, zigzag decodable fountain code, and its decoding algorithms.
Furthermore, we give some comparison a zigzag decodable fountain code with conventional fountain codes by theoretical analysis and computer simulations.

TUTORIAL SESSION

Tutorial 1 :
27 September 2017
08.00 - 09.30

Prof.Dr Zoran Bojkovic
Prof.Dr Bojan Bakmaz
UNIVERSITY OF BELGRADE , SERBIA

"IMPACT OF LATEST COMMUNICATION TECHNOLOGIES ON SMART GRID APPLICATIONS"

Abstract:

The goal of this tutorial is to present recent communication technologies for smart grid (SG) applications in the near future. The operation of distribution networks and the participation of distributed energy resources are based on efficient and reliable communication systems. A variety of communication technologies (wire and wireless) are considered for the next generation networks applications.The first one, comprises optical communications, digital subscriber line and power line communications, They guarantee high reliability, bandwidth, cyber security. The next, wireless technology includes orthogonal - frequency division multiplexing (OFDMA)-based networks (WiMAX,LTE,etc). They are finding a growing interest among electric utilities, thanks to their low cost and easier installation. It should be noted that the high number of existing communication technologies leads to an opportunity for SG applications, even the debate on which technology fits better the SG needs is open. On the other hand, SGs have to be design taking into account the requirements of expected functionalities such as network operation with cooperative distribution energy resources system protection and/or network reconfiguration. From this point of view, the following topics are included, such as: big data, distributed communication architecture, machine-to-machine communication, SG integration with mobile cloud, cyber-physical system perspective., techno-social SGs , traffic type in SG and delivery requirements. For more details and implementation, the audience can be referred to the overview papers, multiple speeches, special issues and the latest books, all presented through the references.

TUTORIAL SESSION

Tutorial 2 :
27 September 2017
09.45 - 11.30

Assoc Prof. Dr. Jiwa abdullah

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING, UNIVERSITI TUN HUSSEIN ONN, MALAYSIA

"MANET/WSN, PERSPECTIVES, ANALYSIS, EDUCATION AND RESEARCH POTENTIALS"

Abstract :

The tutorial session involves the overview of the MANET and WSN which covers the various characteristics that govern the functionalities of these systems. We may cover topics such as: (1) Overview of MANET/WSN; (2) Proactive/Reactive Routing Protocol Analysis; (3) Clustering and Energy Consumption Analysis; (4) Performance analysis for 802.11/802.15.4; (5) WSN Simulation Platform based on Matlab for easy understanding to UG students.

PARALLEL SESSION

26 September 2017
Session 1 : 13:00-14:30

Tracks : COMP **Room : Bakau Room**

No	Time	Title	Authors
1	13.00-13.15	Channel Selection for Common Spatial Pattern Based on Energy Calculation of Motor Imagery EEG Signal	Hilman Fauzi, Ibrahim Shapiai, Noor Akhmad Setiawan, Jafreezal Jaafar and Mahfuzah Mustafa
2	13.15-13.30	Lie Detector with Pupil Dilation and Eye Blinks Using Hough Transform and Frame Difference Method with Fuzzy Logic	Respatyadi Dwiatmojo, Muhammad Nasrun and Casi Setianingsih
3	13.30-13.45	Sentiment Analysis Using Multinomial Logistic Regression	Ramadhan Prakoso, Astri Novianty and Casi Setianingsih
4	13.45-14.00	Indonesia Ancient Temple Classification Using Convolutional Neural Network	Kefin Danukusumo, Pranowo Pranowo and Martinus Maslim
5	14.00-14.15	Adaptive Multilevel Wavelet BCH Code Method in the Audio Watermarking System	Irma Safitri
6	14.15-14.30	3D GPU-Based SPH Simulation of Water Waves Impacting on A Floating Object	Andhika Priyambada and Dede Tarwidi

Session 2 : 13:00-14:30

Tracks : COMM **Room : Bangkirai Room**

No	Time	Title	Authors
1	13.00-13.15	Radiated Emission Test Analyzes Method to Investigate SAR	Erik Madyo Putro, Budi Sulistya, Reza Septiawan, Arief Rufiyanto, Sardjono Trihatmo and Maratul Hamidah
2	13.15-13.30	Low Cost Visible Light Communication Transceiver Prototype for Real Time Data and Images Transfer	Nenggala Yudhabrama, Inung Wijayanto and Sugondo Hadiyoso
3	13.30-13.45	A Smart Power Outlet for Electric Devices That Can Benefit from Real-Time Pricing	Vikram Ramavarapu, Richard Sowers and Ramavarapu Sreenivas
4	13.45-14.00	Path Associativity Centralized Explicit Congestion Control (PACEC) for SDN	Sofia Naning Hertiana, Adit Kurniawan and Hendrawan Hendrawan
5	14.00-14.15	Local Polynomial Regression Based Path Loss Estimation for Weighted Centroid Localization of Endoscopic Capsule	Umma Hany and Lutfa Akter
6	14.15-14.30	Coupling Reduction Between Two Elements of Array Antenna Using U-Shaped Defected Ground Structure	Halason Nabaho, Mochamad Yunus, Edwar Edwar and Achmad Munir

PARALLEL SESSION

26 September 2017
Session 3 : 14:45-16:45

Tracks : EL-REN **Room : Bakau Room**

No	Time	Title	Authors
1	14:45-15.00	Entropy Measurement as Features Extraction in Automatic Lung Sound Classification	Achmad Rizal, Risanuri Hidayat and Hanung Adi Nugroho
2	15.00-15.15	An Interfacing Digital Blood Pressure Meter with Arduino-GSM Module for Real-time Monitoring	Zulfikar Ramli, Sugondo Hadiyoso and Achmad Rizal
3	15.15-15.30	Rehabilitation Exercise Monitoring Device for Knee Osteoarthritis Patients	Mitra Mohd Addi and Nur Amirah Ishak
4	15.30-15.45	Feasibility Study of Ocean Wave Energy for Wave Power Plant at Sibolga-Tapanuli Tengah	Riswan Dinzi, Hendrik Hutagalung and Fahmi Fahmi
5	15.45-16.00	Fuzzy Logic Based Active Power Generation Dispatching Considering Intermittent Wind Power Plants Output	Fatmawati Azis, Ardiaty Arief and Muhammad Nappu
6	16.00-16.15	Design of Solar Water Pumping System in Urban Residential Building	Prisma Megantoro, Danang Wijaya and Eka Firmansyah
7	16.15-16.30	Design of Hybrid PV-Generator-Battery System for Two Kind of Loads at Aha Village, Morotai Island, North Maluku	Salmon Hutapea and Agus Purwadi
8	16.30-16.45	Electricity Price and Subsidy Scenario for Hybrid Power Generations on Off-Grid System	Fadolly Ardin, Amien Rahardjo and Chairul Hudaya

PARALLEL SESSION

26 September 2017
Session 4 : 14:45-16:45

Tracks : COMM **Room : Bangkirai Room**

No	Time	Title	Authors
1	14.45-15.00	Equivalent Circuit Analysis of Square-Loop-Resonator BPF with CrossShaped I/O Coupling for X-Band Frequency Application	Edwar Edwar and Achmad Munir
2	15.00-15.15	Square Ring Microstrip Patch Triple Band Antenna for GSM/ WLAN/ WiMAX System	Abdulrashid Mumin, Jiwa Abdullah, Rozlan Alias, Samsul Haimi Dahlan and Raed Abdulkareem Abdulhasan
3	15.15-15.30	Dual List Interference Cancellation in Underlay Cognitive Radio	Linda Meylani, Adit Kurniawan and Mohammad Sigit Arifianto
4	15.30-15.45	Performance Analysis of Hybrid Optical Amplifier in Long-Haul Ultra-Dense Wavelength Division Multiplexing System	Brian Pamukti Sunardi and Akhmad Hambali
5	15.45-16.00	Cohn Topology-based 1:8 Power Divider for S-Band Array Antenna Feeding Network	Achmad Munir, Endon Bharata and Edwar Edwar
6	16.00-16.15	Trilateration and Iterative Multilateration Algorithm for Localization Schemes on Wireless Sensor Network	Matsna Rahman, Ratna Mayasari and Ahmad Hanuranto

27 September 2017
Session 5 : 08:00-09:30

Tracks : COMP **Room : Bangkirai Room**

No	Time	Title	Authors
1	08.00-08.15	Spatiotemporal Saliency Detection in Traffic Surveillance	Wei Li, Dhoni Putra Setiawan and Hua-An Zhao
2	08.15-08.30	Analysis of Flight Data Recorder Compression Reliability for Airplane on Demand Blackbox Data Transmission	Dhipo Putra, Surya Michrandi Nasution and Fairuz Azmi
3	08.30-08.45	Analysis of Cockpit Voice Recorder Compression Reliability for Airplane on Demand Blackbox Data Transmission	Setianto Nugroho, Surya Michrandi Nasution and Fairuz Azmi
4	08.45-09.00	Interpolating Redundant Spatial Data from SHUMOO Boat Survey Due to the Current Directions of Anyar River	Putu Harry Gunawan and Ketut Tomy Suhari
5	09.00-09.15	Flood Forecasting Using Holt-Winters Exponential Smoothing Method and Geographic Information System	Mus'ab Abdurrahman, Budhi Irawan and Roswan Latuconsina
6	09.15-09.30	Parallel Processing for Simulating Surface Gravity Waves by Non-hydrostatic Model Using Arakawa Grid	Putu Harry Gunawan and Mintho L. P. Siagian

PARALLEL SESSION

27 September 2017
Session 6 : 09:45-11:30

Tracks : COMP **Room : Bangkirai Room**

No	Time	Title	Authors
1	09.45-10.00	An Implementation of Weighted Moving Average and Genetic Programming for Rainfall Forecasting in Bandung Regency	Budy Putra, Fhira Nhita, A Adiwijaya, Deni Saepudin and Untari Wisesty
2	10.00-10.15	*Analysis Security Metric on BRO IPS Based on CVSS and VEA-bility Metric*	I Made Dwi Suryadinata, Surya Michrandi Nasution and Marisa Paryasto
3	10.15-10.30	Retinal Vessel Detection Based on Frangi Filter and Morphological Reconstruction	Hanung Adi Nugroho, Rezty Amalia Aras, Tri Lestari and Igi Ardiyanto
4	10.30-10.45	Computational Acceleration of Image Inpainting Alternating-Direction Implicit (ADI) Method Using GPU CUDA	Mutaqin Akbar, Pranowo Pranowo and Suyoto Suyoto
5	10.45-11.00	Computing Two-layer SWE for Simulating Submarine Avalanches on OpenMP	Putu Harry Gunawan and Cassrio Agustin Simanjuntak
6	11.00-11.15	Automation System for Controlling and Monitoring Ornamental Plants Using Fuzzy Logic Method	Rihla Ubudi, Budhi Irawan and Randy Saputra
7	11.15-11.30	Solution Path of Newton's Method for Determining Epicenter Earthquake Hazard in Italy 24 August 2016	Putu Harry Gunawan and Nadzar Prakoso

PARALLEL SESSION

26 September 2017
Session 7 : 13:00-14:30

Tracks : COMP **Room : Bakau Room**

No	Time	Title	Authors
1	13.00-13.15	PID Temperature Controlling of Thermoelectric Based Cool Box	Sundayani Sundayani, Dyan Sinulingga, Fabiola Prasetyawati, Firmawan Palebangan, Asep Suhendi, Ismudiati Puri Handayani, Tri Ayodha Ajiwiguna and Indra Fathona
2	13.15-13.30	Quadrotor Model with PD Controller	Harits Anwar Rozi, Erwin Susanto and Prasetya Dwi Wibawa
3	13.30-13.45	Realization of Depth First Search Algorithm on Line Maze Solver Robot	Ahmad Syarif Hidayatullah, Agung Nugroho Jati and Casi Setianingsih
4	13.45-14.00	A Multi-Agent System for Solar Driven DC Microgrid	Diana Severine Rwegasira, Imed Saad Ben Dhaou, Aron Kondoro, Naiman Shililiandumi, Amleset Kelati, Nerey Mvungi and Hannu Tenhunen
5	14.00-14.15	Autonomous VTOL Design in Quadcopter Using Feedback Linearization and Fuzzy T-S	Chalidia Nurin Hamdani, Mohammad Nuh and Rusdhianto Efendi Abdul Kadir
6	14.15-14.30	Control System Implementation and Analysis for Omniwheel Vehicle	Andra Bramanta, Agus Virgono and Randy Saputra

Session 8 : 13:00-14:30

Tracks : COMM **Room : Bangkirai Room**

No	Time	Title	Authors
1	13.00-13.15	Performance Analysis of Hybrid AF and DF Protocol for Relay Networks	Dhoni Putra Setiawan and Hua-An Zhao
2	13.15-13.30	Identifying 4G Service Attributes on Customer Satisfaction in Indonesia Market: Kano Model Approach	Al Bukhari Pahlevi and Muhammad Suryanegara
3	13.30-13.45	Performance Analysis of Message Drop Control Source Relay (MDC-SR) in Maxprop DTN Routing	Aditya Nikolas Putra, Leanna Yovita and Tody Wibowo
4	13.45-14.00	Antenna MIMO 8×8 Array 2 Patch Rectangular H-Slot for 5G Access Radio at Frequency 15 GHZ	Adhie Surya Ruswanditya, Heroe Wijanto and Yuyu Wahyu
5	14.00-14.15	The Anyar River Depth Mapping from Surveying Boat (SHUMOO) Using ArcGIS and Surfer	Putu Harry Gunawan and Ketut Tomy Suhari
6	14.15-14.30	Leveraging Crime Reporting in Metro Manila Using Unsupervised Crowd-sourced Data: A Case for the iReport Framework	Bernie S Fabito, Angelique Lacasandile, Arlene Trillanes and Emeliza Yabut

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An Interfacing Digital Blood Pressure Meter with Arduino-GSM Module for Real-time Monitoring

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***Abstract*— Heart health is one of the parameters of one's health condition. Besides using the ECG machine, heart conditions can be determined through blood pressure measurement. Patient's hypertension requires the continuous blood pressure measurement. In some conditions, the health of patients cannot be directly checked at healthcare center. For this, the mobile blood pressure meter devices can send data in real time are deemed necessary. The paper discussed about the realization of an interface system that can automatically transmit the blood pressure measurements via Short Message Service (SMS) addressed to the doctor or the medical expert. The result then showed the validity of the test in the form of validation of sensor measurement data and output data SMS (systolic and diastolic). Based on the overall system test waiting time or delay between sending and receiving was at 46.27 seconds for once measurement.**

Keywords—Heart, Blood Pressure, real time, SMS

I. INTRODUCTION

Heart is a vital organ of a human who requires much attention to keep it healthy. On the other hand, heart disease becomes one of the main causes of death in the world, and most people are still not aware of the importance of maintaining cardiac health. One of the causes of heart disease is hypertension – a condition where; blood pressure exceeds a normal pressure. Some patients with hypertension require an intensive care and monitoring to avoid a heart attack [1]. Hypertension is influenced by a number of psychological conditions and stress levels causing the blood pressure change suddenly [2]. The category of high blood pressure is >140mmHg systolic pressure, or ≥90 mm Hg diastolic pressure [3].

For patients, periodic blood pressure check and consultation with medical experts is very important. With the reason of busyness, such check and consultation, however, are sometimes difficult to be done by the patient. In the purpose of consultation, a mobile blood pressure device is required to send the blood pressure value for the medical experts. Patients can conduct the blood pressure checks by themselves and consult with medical experts anytime and anywhere. In other words, it takes a Tele-monitoring application to resolve the issue. One of communication media for telemonitoring application is SMS services via the GSM network that can be widely accessed.

Many studies have been conducted on blood pressure monitoring systems. Research on blood pressure data transmission for Tele-monitoring applications based on GSM module was reported by A. Srividhya [4]. The study reported a system of data transmission for blood pressure measurement based on GSM communication but did not discuss in detail about the results of measurement.

Another research by Dai Houde [5] developed the mobile blood pressure monitor with the wireless communication interface. Dai Houde applied a wireless communication module: NanoLOC AVR as a medium for transmitting data to the server. For further development, it needed integration with a PC or a mobile phone for computation.

Mandeep Singh [6] developed a smartphone-based wireless blood pressure monitoring system using Bluetooth. The results of blood pressure measurement were sent to the mobile phone via Bluetooth and displayed on the Android app.

From the description above it can be concluded that the needs of mobile devices for vital signs in monitoring human health is very important. One of the applications that is paid much attention is the monitoring of blood pressure. This paper aims to discuss the realization of digital BP meter system integrated with GSM network for monitoring a patient's blood pressure in real time. The patient can do the measurements by himself/herself and the device will automatically send the systole and diastole data to medical experts via SMS. The urgency of this research is the implementation of a system in health tele-monitoring for areas that are not reached by the internet service.

In our research, we developed blood pressure measurement system based on E-Health module. E-Health module was integrated with the Arduino to read the measurement data and then to be sent via short message service using the SIM 900 module. This environment is expected to help patient particularly outpatients to able to establish a communication with the medical expert periodically and for some emergency

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cases, real-time applications are required. By so doing, the medical expert still could monitor patients' health remotely and provide early treatment if something happens to the patient.

The main contents of this paper are organized as follows; Section II describes the basic theory of digital blood pressure meter, E-health module and GSM module. Section III presents a description of system implementation. Section IV provides a brief description of the result discussed and this paper is ended with the conclusion given in Section V.

II. Basic Theory and Materials

A. *Digital Blood Pressure Meter*

The measurement of blood pressure is a measure of pressure in the arteries using a sphygmomanometer also called as tension meter. In this work, we used an automatic digital blood pressure meter product from Kodea (Model: KD 202F).

The device supports integration with other devices such as a PC, smartphone, or a microcontroller via USB for health management purposes. In this work, the blood pressure monitor was connected to the Arduino via E-Health Module.

B. *E-Health Sensor Shield*

E-Health sensor shield is a special module designed to meet the needs of medical device design based on Arduino. It is used for a communication interface between the sensor (BP meter) with Arduino. Figure 1 shows the E-Health sensor.

Fig 1. E-Health Shield [7]

C. *GSM Modem*

In this research, we used Wavecom Fastrack M1306B series modem as an SMS sender module. Wavecom modem enables Arduino board connected to a mobile network to send and receive SMS either in the form of text or in the PDU format. In principle, the process of sending and receiving SMS on Wavecom modem used AT command.

III. Implementation

This section describes the implementation of the system in detail including the scheme, system illustration, hardware, and software installation.

A. *Scheme of Systems*

Blood pressure meter for real-time monitoring via SMS service consists of Arduino board, E-Health shield, blood pressure sensor, Wavecom Module and software platform. Fig 2 and Fig 3 display the scheme and illustration of the system.

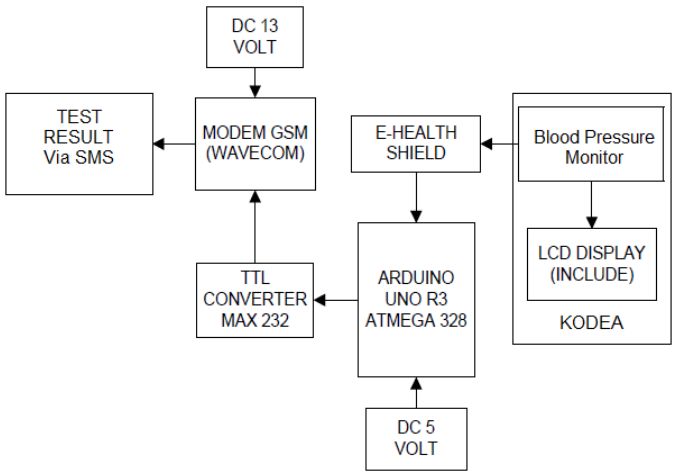

Fig 2. Block Diagram

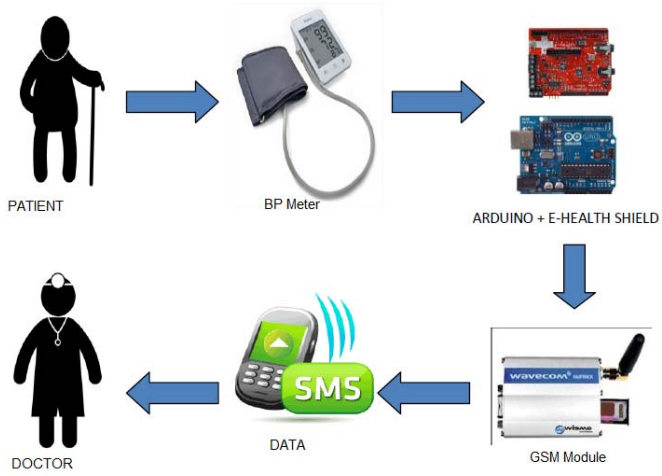

Fig 3. Illustration of Blood pressure measurement

In this system, the patient can do blood pressure measurement by means of the BP meter by himself/herself. After measurement, it will get the measurement results such as the systolic pressure, diastolic pressure, and heart rate. Automatically by the sensor, measurement data are transmitted in a serial mode to Arduino and will be processed by the microcontroller.

The data processed by a microcontroller automatically would be forwarded to the modem Wavecom Fastrack that has been integrated into Arduino board to send the measurement results to a medical specialist via SMS.

B. *Hardware Installation*

The overall design of the system was done by connecting the blood pressure sensor on E-Health Shield, which has been connected to the Arduino board. Arduino was also connected

to the GSM module with TTL to RS232 converter. Data rates for serial communication between the microcontroller, sensor and GSM module was 115200 bps. Data format setting was also conducted to create synchronization between sender and receiver. Hardware installation can be seen in Fig 4.

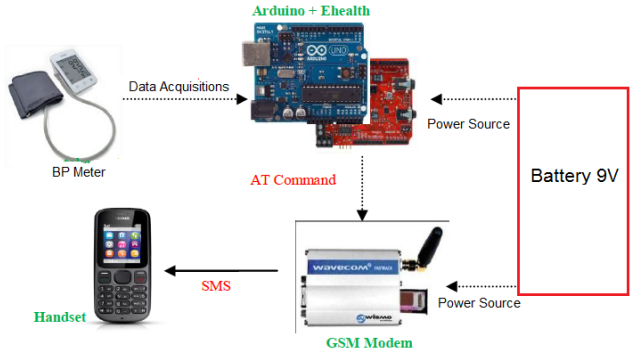

Fig 4. Hardware Implementation

Data communication between Wavecom modem and Arduino was run via null modem and TTL to RS232 converter. The wiring diagram of communication can be seen in Fig 5.

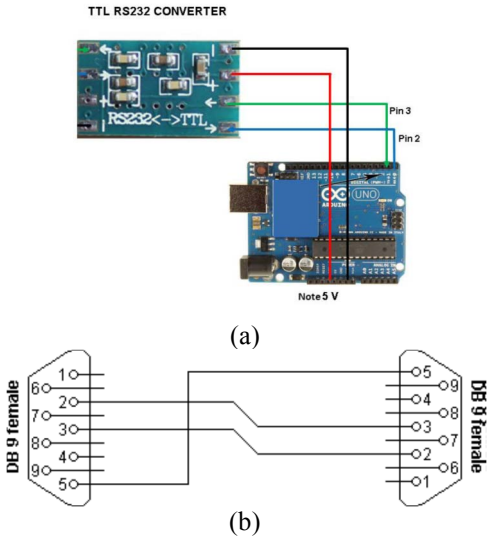

Fig 5. Wiring Diagram (a) TTL converter (b) null modem

C. *Software Installation*

Figure 6 describes the workflow of process system; the measurement was started when a patient used a cuff connected to BP meter. The measurement results obtained systolic pressure, diastolic pressure and heart rate simultaneously. Furthermore, the measurement data from the sensors would be sent via the serial data to Arduino Shield E-health. Finally, serial data would be processed by a microcontroller and sent via modem.

The measurement data was displayed via the SMS service in accordance with the authentication recipient.

The listing program of data transmission using the SMS based on AT-Command is presented as follows

```
void SendTextMessage() {
char mychar = 13;
char mychar2 = 26;
  mySerial.print("AT+CMGF=1\r");
  delay(100);
  mySerial.println("AT + CMGS = \"+628231705xxx\"");
  delay(100);
  mySerial.print(F("Systolic value : "));

mySerial.print(30+eHealth.bloodPressureDataVector[x]
.systolic);
  mySerial.println(F(" mmHg"));
  mySerial.print(F("Diastolic value : "));

mySerial.print(eHealth.bloodPressureDataVector[x].di
astolic);
  mySerial.println(F(" mmHg"));
  mySerial.print(F("Pulse value : "));

mySerial.print(eHealth.bloodPressureDataVector[x].pu
lse);
  mySerial.println(F(" bpm"));
  while (1>0);
```

IV. Result and Discussion

In this section we discuss the results of the testing system. The analysis is focused on the blood pressure data communication device as well as the performance of communication with Arduino GSM modem to send a short message service.

A. *Communication BP Monitor with Arduino*

This test aimed to determine whether the data presented by BP monitor successfully received Arduino before being forwarded to a GSM modem. Measurement data was sent serially by the Arduino to the PC for data validation. In each time sending the data consisted of a value of systole, diastole and pulse rate values. Arduino was programmed to send the latest measurement data only once in each test. Figure 6 show the testing scenario while Fig 7 display the BP measurement result on the serial monitor.

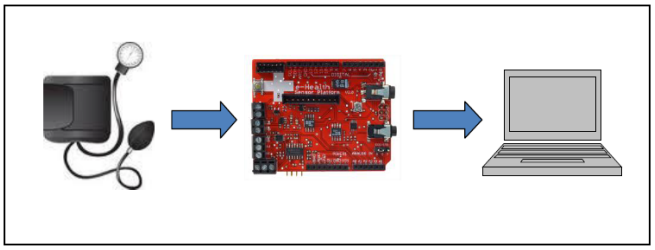

Fig 6. Sample test data transfer from BP monitor

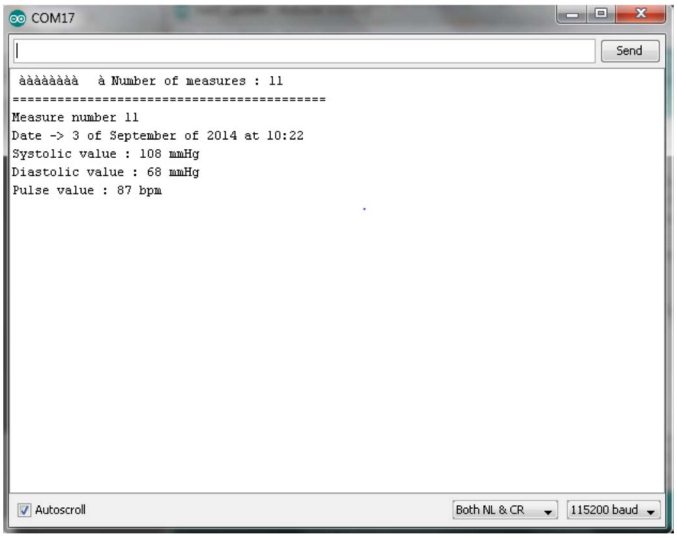

Fig 7. Sample data

B. *Testing communication Arduino with GSM Modem*

Interface testing between Arduino with GSM module aimed to determine the successful delivery of a short message and to observe the length of waiting time (delay) delivery. A total of 20 samples was sent over a GSM modem by the microcontroller and calculated the delay. The average delay message delivery was 16.75 seconds with the standard deviation of 1,251. The values of standard deviation were relatively low indicating that the difference of delay value was little. The delay test results can be seen in Fig 8.

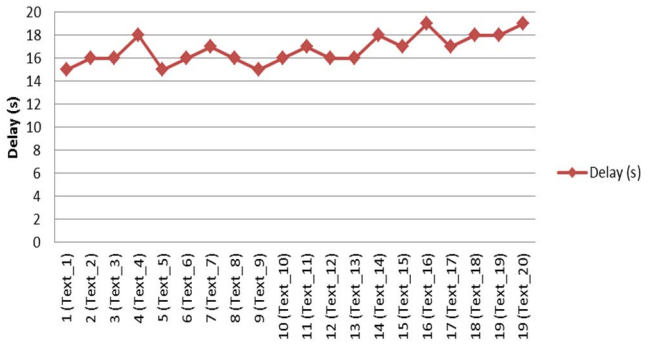

Fig 8. SMS Delay

Fig 9. Sample SMS display on handset

C. *Testing of Systems Integration*

Testing the overall system was accomplished by integrating the entire circuit or the configuration of all modules required in the design of this system. Blood pressure sensor needed to be connected to the E-Health Shield, which has been connected to the Arduino board. At the same time, Arduino should also be connected to the GSM module. For the serial communication between the microcontroller, sensor and GSM module, they were set at the same rate. In addition, the type of data being transmitted in the program must also be set to synchronize transmitter and receiver.

TABLE 1. TEST RESULT OF INTEGRATED SYSTEMS

Pat. ID	Systole	Diastole	HR	Delivery Status	Text Status	Delay (s)
1	128	73	84	sent	Valid	34
2	107	82	83	sent	Valid	35
3	117	78	83	sent	Valid	33
4	111	78	83	sent	Valid	40
5	104	75	84	sent	Valid	46
6	108	78	78	sent	Valid	33
7	125	79	80	sent	Valid	35
8	117	79	86	sent	Valid	35
9	120	85	86	sent	Valid	35
10	131	115	99	sent	Valid	38
11	126	87	89	sent	Valid	42
12	111	94	87	sent	Valid	39
13	148	138	101	sent	Valid	40
14	138	84	85	sent	Valid	122
15	125	87	81	sent	Valid	44
16	116	81	81	sent	Valid	38
17	149	114	114	sent	Valid	41
18	116	87	86	sent	Valid	44
19	134	113	91	sent	Valid	54
20	120	85	86	sent	Valid	74
21	127	89	89	sent	Valid	65
22	125	89	89	sent	Valid	94
23	126	89	88	not sent	N/A	N/A
24	133	97	85	not sent	N/A	N/A

Fig 10. validation of the results between the sensor data and SMS data

From the test results as shown in Table 1, it can be stated that the measurement data was successfully sent. When referring to the GSM communication the test results only

showing text messages can show a waiting time difference or delay between sending and receiving SMS.

Of 24 times of testing, the range of delay between transmitting and receiving SMS was from 33 to 122 seconds, and the average was 48.27 seconds. This result was related to the relatively slower data processing in the microcontroller as the microcontroller must acquire data from sensors in advance before being processed into a short message format and sent to the medical side.

V. CONCLUSIONS

In this paper, we presented an implementation of blood measurement system with GSM module for telemonitoring. The evaluation result showed that the system could work appropriately. Tha data resulted from measurement were sent and received with a valid value via SMS. The average delay in the transmission was 48.27 seconds. The connection between the blood pressure sensor and Arduino could not run simultaneously when the data acquisition process by the microcontroller were running. Thus, when a data acquisition process would be performed, the cable between the sensor and the e-health shield must be manually connected.

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