



Special Issue on Intelligent Electronic Devices

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Abstract: The second IEEE International Conference on Knowledge Innovation and Invention 2019 (IEEE ICKII 2019) was held in Seoul, South Korea, 12–15 July 2019. This special issue “Intelligent Electronic Devices” selects 13 excellent papers from 260 papers presented in IEEE ICKII 2019 conference about the topics of Intelligent Electronic Devices. The main goals of this special issue are to encourage scientists to publish their experimental and theoretical results in as much detail as possible, and to discover new scientific knowledge relevant to the topics of electronics.

Keywords: electrical circuits and devices; computer science and engineering; communications and information processing

1. Introduction

In a modern technological society, electronic engineering and design innovations are both academic and practical engineering fields that involve systematic technological materialization through scientific principles and engineering designs. Engineers and designers must work together with a variety of other professionals in their quest to find systems solutions to complex problems. Fast advances in science and technology have broadened the horizons of engineering, whilst simultaneously creating a multitude of challenging problems in every aspect of modern life. Current research is interdisciplinary in nature, reflecting a combination of concepts and methods that often span several areas of mechanics, mathematics, electrical engineering, control engineering, and other scientific disciplines. In addition, the second IEEE Conference on Knowledge Innovation and Invention 2019 (IEEE ICKII 2019) was held in Seoul, South Korea, 12–15 July 2019, and it provided a unified communication platform for researchers in the topics of information technology, innovation design, communication science and engineering, industrial design, creative design, applied mathematics, computer science, electrical and electronic engineering, mechanical and automation engineering, green technology and architecture engineering, material science, and other related fields. This special issue on “Intelligent Electronic Devices” selected 13 excellent papers from 260 papers presented in IEEE ICKII 2019 on the topics of intelligent electronic devices. The fields include as follows: electrical circuits and devices, computer science and engineering, and communications and information processing. The main goals of this special issue are to encourage scientists to publish their experimental and theoretical results in as much detail as possible, and to discover new scientific knowledge relevant to the topics of electronics.

2. The Topics of Intelligent Electronic Device and Its Applications

This special issue on “Intelligent Electronic Devices” selected 13 excellent papers from 260 papers presented in IEEE ICKII 2019 on the topics of electronics. The published papers are introduced as follows:

Lei et al. reported “Learning Effective Skeletal Representations on RGB Video for Fine-Grained Human Action Quality Assessment” [1]. In this paper, the authors propose an integrated action classification and regression learning framework for the fine-grained human action quality assessment of RGB videos. On the basis of 2D skeleton data obtained per frame of RGB video sequences, the authors present an effective representation of joint trajectories to train action classifiers and a class-specific regression model for a fine-grained assessment of the quality of human actions. To manage the challenge of view changes due to camera motion, the authors develop a self-similarity feature descriptor extracted from joint trajectories and a joint displacement sequence to represent dynamic patterns of the movement and posture of the human body. To weigh the impact of joints for different action categories, a class-specific regression model is developed to obtain effective fine-grained assessment functions. The experimental results show that the proposed method achieved an improved performance, which is measured by the mean rank correlation coefficient between the predicted regression scores and the ground truths.

Lee et al. reported “A Hybrid Tabu Search and 2-opt Path Programming for Mission Route Planning of Multiple Robots under Range Limitations” [2]. In this study, the application of an unmanned vehicle system allows for accelerating the performance of various tasks. Due to limited capacities, such as battery power, it is almost impossible for a single unmanned vehicle to complete a large-scale mission area. An unmanned vehicle swarm has the potential to distribute tasks and coordinate the operations of many robots/drones with very little operator intervention. Therefore, multiple unmanned vehicles are required to execute a set of well-planned mission routes, in order to minimize time and energy consumption. A two-phase heuristic algorithm was used to pursue this goal. In the first phase, a tabu search and the 2-opt node exchange method were used to generate a single optimal path for all target nodes; the solution was then split into multiple clusters according to vehicle numbers as an initial solution for each. In the second phase, a tabu algorithm combined with a 2-opt path exchange was used to further improve the in-route and cross-route solutions for each route. This diversification strategy allowed for approaching the global optimal solution, rather than a regional one with less CPU time. After these algorithms were coded, a group of three robot cars was used to validate this hybrid path programming algorithm.

Chien et al. reported “Research on Anti-Radiation Noise Interference of High Definition Multimedia Interface Circuit Layout of a Laptop” [3]. In this paper, several aspects were studied, including the effect of an electromagnetic interference (EMI) noise interference strategy with High Definition Multimedia Interface (HDMI) 1.4, the analysis of a test on a printed circuit board (PCB) layout, and a comparison of the near field intensity radiation distribution between an EMI with a modified HDMI layout and an original layout. The near field detection instrument of APREL EM-ISight was employed to analyze the distribution of the strength of an electromagnetic noise field. After the practical validation, we found that the PCB layout complies with the standards after the modifications. Meanwhile, the PCB layout satisfies the requirements of most laptop HDMI-related products for EMI.

Du et al. reported “Stereo Vision-Based Object Recognition and Manipulation by Regions with Convolutional Neural Network” [4]. This paper develops a hybrid algorithm of adaptive network-based fuzzy inference system (ANFIS) and regions with convolutional neural network (R-CNN) for stereo vision-based object recognition and manipulation. The stereo camera at an eye-to-hand configuration firstly captures the image of the target object. Then, the shape, features, and centroid of the object are estimated. Similar pixels are segmented by the image segmentation method, and similar regions are merged through selective search. The eye-to-hand calibration is based on ANFIS to reduce computing burden. A six-degree-of-freedom (6-DOF) robot arm with a gripper will conduct experiments to demonstrate the effectiveness of the proposed system.

Perng et al. reported “An Electromagnetic Lock Actuated by a Mobile Phone Equipped with a Self-Made Laser Pointer” [5]. The main purpose of this study was to create an acousto-optic control lock device to convert electrical signals with a specific sound command using an acousto-optic conversion module, thereby improving the reliability and safety of opening or closing remote controlled door

locks, such as car central locks or rolling doors. We used music playing through a smart phone speaker to create a special laser pointer to connect with the auxiliary input of the smart phone. The laser pointer (wavelength of 630 to 650 nm and maximum output of 5 mw) lights up when the music of the smart phone starts playing at a music frequency matching the light frequency. When the solar panel receives light, it converts the frequency of the light signal into an electrical frequency signal. The current is amplified using the power amplifier and then the amplified current flows to the sound recognition module. The sound recognition module performs audio comparison on the set sound signal, and once the comparison is correct, the output voltage activates the electromagnetic switch on the door to open or close it.

Lin et al. reported “Electrostatic-Discharge-Immunity Impacts in 300 V nLDMOS by Comprehensive Drift-Region Engineering” [6]. This paper focuses on comprehensive drift-region engineering for ultra-high-voltage (UHV) circular n-channel lateral diffusion metal-oxide-semiconductor transistor (nLDMOS) devices used to investigate impacts on ESD ability. Under the condition of fixed layout area, there are four kinds of modulation in the drift region. First, by floating a polysilicon stripe above the drift region, the breakdown voltage and secondary breakdown current of this modulation can be increased. Second, adjusting the width of the field-oxide layer in the drift region when the width of the field-oxide layer is 5.8 μm will result in the minimum breakdown voltage (105 V), but the best secondary breakdown current (6.84 A). Third, by adjusting the discrete unit cell and its spacing, the corresponding improved trigger voltage, holding voltage, and secondary breakdown current can be obtained. According to the experimental results, the holding voltage of all devices under test (DUTs) is greater than that of the reference group, so the discrete HV N-Well (HVNW) layer can effectively improve its latch-up immunity. Finally, by embedding different P-Well lengths, the findings suggest that when the embedded P-Well length is 9 μm , it will have the highest ESD ability and latch-up immunity.

Lam et al. reported “Generative Noise Reduction in Dental Cone-Beam CT by a Selective Anatomy Analytic Iteration Reconstruction Algorithm” [7]. In this paper, the authors propose a new algorithm called the selective anatomy analytic iteration reconstruction (SA2IR) algorithm for the sparse-projection set. The algorithm was simulated on a phantom structure analogous to a patient’s head for geometric similarity. The proposed algorithm is projection-based. Interpolated set enrichment and trio-subset enhancement were used to reduce the generative noise and maintain the scan’s clinical diagnostic ability. The results show that the proposed method was highly applicable in medico-dental imaging diagnostics fusion for the computer-aided treatment planning, because it had significant generative noise reduction and lowered computational cost when compared to the other common contemporary algorithms for sparse projection, which generate a low-dosed CBCT reconstruction.

Shen et al. reported “Dual-Input Isolated DC-DC Converter with Ultra-High Step-Up Ability Based on Sheppard Taylor Circuit” [8]. A dual-input high step-up isolated converter (DHSIC) is proposed in this paper, which incorporates Sheppard Taylor circuit into power stage design so as to step up voltage gain. In addition, the main circuit adopts boosting capacitors and switched capacitors, based on which the converter voltage gain can further be improved significantly. Since the proposed converter possesses an inherently ultra-high step-up feature, it is capable of processing low input voltages. The DHSIC also has the important features of leakage energy recycling, switch voltage clamping, and continuous input-current obtaining. These characteristics have an advantage on converter efficiency and benefit the DHSIC for high power applications. The structure of the proposed converter is concise. That is, it can lower cost and simplifies control approach. The operation principle and theoretical derivation of the proposed converter are discussed thoroughly in this paper. Simulations and hardware implementation are carried out to verify the correctness of theoretical analysis and to validate feasibility of the converter as well.

Tseng et al. reported “Secondary Freeform Lens Device Design with Stearic Acid for A Low-Glare Mosquito-Trapping System with Ultraviolet Light-Emitting Diodes” [9]. This study is dedicated to the development of a new mosquito-trapping system. Research has shown that specific wavelengths, colors, and temperatures are highly attractive to both *Aedes aegypti* and *Aedes albopictus*. The authors

create equipment which effectively improves the trapping capabilities of mosquitoes in a wider field. The design of the special Secondary Freeform Lens Device (SFLD) is used to expand the range for trapping mosquitoes and create illumination uniformity; it also directs light downward for the protection of users' eyes. In addition, we use the correct amount of stearic acid as a mosquito attractant to allow a better control effect against mosquitoes during the day. In summary, when the UV LED mosquito trapping system is combined with a quadratic free-form lens, the experimental results show that the system can extend the capture range to $100 \pi \text{ m}^2$, in which the number of captured mosquitoes is increased by about 350%.

Wei et al. reported "Using Different Ions in the Hydrothermal Method to Enhance the Photoluminescence Properties of Synthesized ZnO-Based Nanowires" [10]. In this study, ZnO films with a thickness of $\sim 200 \text{ nm}$ were deposited on SiO_2/Si substrates as the seed layer. Then, $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ and $\text{C}_6\text{H}_{12}\text{N}_4$ containing different concentrations of $\text{Eu}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$ or $\text{In}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$ were used as precursors, and a hydrothermal process was used to synthesize pure ZnO as well as Eu-doped and In-doped ZnO nanowires at different synthesis temperatures. The effect of different concentrations of Eu^{3+} and In^{3+} ions on the physical and optical properties of ZnO-based nanowires was well investigated. FESEM observations found that the undoped ZnO nanowires could be grown at 100°C . The temperatures required to grow the Eu-doped and In-doped ZnO nanowires decreased with increasing concentrations of Eu^{3+} and In^{3+} ions. XRD patterns showed that with the addition of Eu^{3+} (In^{3+}), the diffraction intensity of the (002) peak slightly increased with the concentration of Eu^{3+} (In^{3+}) ions and reached a maximum at 3 (0.4) at%. It is revealed that the concentrations of Eu^{3+} and In^{3+} ions have considerable effects on the synthesis temperatures and photoluminescence properties of Eu^{3+} -doped and In^{3+} -doped ZnO nanowires.

Ulansky et al. reported "Electronic Circuit with Controllable Negative Differential Resistance and its Applications" [11]. In this paper, a new NDR circuit that comprises a combination of a field effect transistor (FET) and a simple bipolar junction transistor (BJT) current mirror (CM) with multiple outputs is proposed. A distinctive feature of the proposed circuit is the ability to change the magnitude of the NDR by increasing the number of outputs in the CM. Mathematical expressions are derived to calculate the threshold currents and voltages of the N-type current-voltage characteristics for various types of FET. The calculated current and voltage thresholds are compared with the simulation results. The possible applications of the proposed NDR circuit for designing single-frequency oscillators and voltage-controlled oscillators (VCO) are considered. The designed NDR VCO has a very low level of phase noise and has one of the best values of a standard figure of merit (FOM) among recently published VCOs. The effectiveness of the proposed oscillators is confirmed by the simulation results and the implemented prototype.

Zhang et al. reported "Low Cost Test Pattern Generation in Scan-Based BIST Schemes" [12]. This paper proposes a low-cost test pattern generator for scan-based built-in self-test (BIST) schemes. Our method generates broadcast-based multiple single input change (BMSIC) vectors to fill more scan chains. The proposed algorithm, BMSIC-TPG, is based on our previous work multiple single-input change (MSIC)-TPG. The broadcast circuit expends MSIC vectors, so that the hardware overhead of the test pattern generation circuit is reduced. Simulation results with ISCAS'89 benchmarks and a comparison with the MSIC-TPG circuit show that the proposed BMSIC-TPG reduces the circuit hardware overhead at about 50%, ensuring low power consumption and high fault coverage.

Pamungkas et al. reported "Overview: Types of Lower Limb Exoskeletons" [13]. In order to provide information about which actuator location is more suitable; a review study on the design of actuator locations is presented in this paper. The location of actuators is an important factor because it is related to the analysis of the design and the control system. This factor affects the entire lower limb exoskeleton's performance and functionality. In addition, the disadvantages of several types of lower limb exoskeletons in terms of actuator locations and the challenges of the lower limb exoskeleton in the future are also presented in this paper.

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