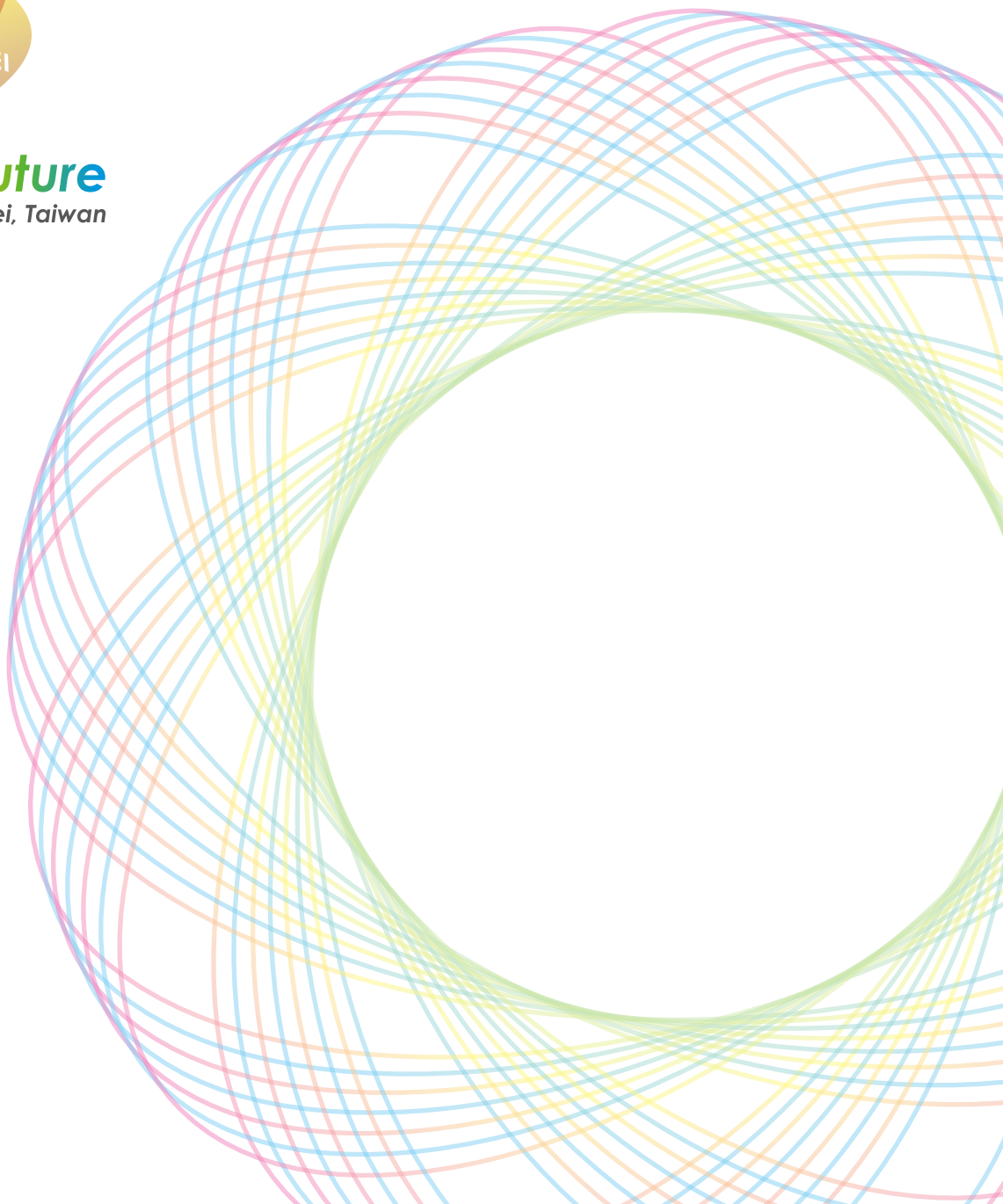
The 7th ASIA COLOR ASSOCIATION CONFERENCE

ABSTRACTS of

ACA 2022 TAIPEI

Color for Future

Oct. 20-21, 2022, Taipei, Taiwan



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Taiwan Association of Color Applications (TACA)

This publication includes abstracts of the keynote, oral and poster papers presented in the 7th Conference of Asia Color Association (ACA), 2022. The theme of the conference was Color For Future. The conference, organised by Color Association of Taiwan (CAT), was held in Webex, on 20-21 October 2022.

More information: https://www.aca2022.taipei

https://www.aca2022.taipei

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WELCOME MESSAGE

On behalf of the ACA 2022 Organizer, I welcome each of you to the 2022 7th ACA Conference – Color for Future. It's an exciting time for CAT (Color Association of Taiwan) as we continue to grow and remaining always motivated and responsive open to new ideas. Although our organization is confronting a time of many unexpects and we're meeting these critical pandemic challenges during the on-going period of larger nation-wide and global changes. The world of color study still has so many exciting areas in which to work/study/live, and we'll continue to meet and bring inspired people together in forums like this, to ensure our ACA remains at the cutting edge.

In the next few days, during the "Color for future" ACA conference, we build up the internet platform to bring you 5 keynotes, which contains futuristic thinking to explore the possibilities of how color will be applied in the virtual world. Another 30 oral papers and 30 video-presented-posters with on-line interaction of various color research fields will be presented as well. In addition, 5 invited talks of "Color for future" special session will be also available for your participation.

During last 6 ACA conferences we already encouraged and cultivated Asian color studies all around Asia. Many young scholars dedicate themselves to the fields of color study intelligently. We're now transforming the conventional way we usually operate into web-based internet conference, hope this new form will continuously improve our ability to communicate, present and network. Our team members and partners have continued to meet the challenges of our fields and to excel despite setbacks. We should all be very proud of where we are today and excited about where we are headed.

I'd like to thank each of you for attending the conference and bringing your expertise to our gathering. You, as color expert, have the vision, the knowledge, and the experience to help us pave our way into the future color usages and applications. You are truly our greatest asset today and tomorrow, and we could not accomplish what we do without your support and participate. Throughout this 7th ACA conference, I ask you to stay engaged, keep us proactive and help us shape the future of Asia Color Association. My personal respect and thanks go out to all of you.

Lee, Tien-Rein
Chair of the 2022 the 7th ACA Conference
President
Color Association of Taiwan

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PROGRAM

Time (UTC+8)	October 20 (Thu.)	
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9:50	Short Break	
10:00–10:40	Keynote 2 Challenges and Opportunities in Color Science Introduced by Metaverse Dr. Min-Chen Wei	
10:40	Short Break	
10:50–11:50	Oral Session 1 Color Vision	Oral Session 2 Color in Art & Design
11:50–13:30	Long Break	
13:30–14:45	Oral Session 3 Color Management	Oral Session 4 Color & Culture
14:45–15:00	Short Break	
15:00–16:40	Special Session: Color for future	
	Transforming Cultural Relics into Interactive Multimedia through Color Design Tony Liu (Bright Ideas Design)	
	Unlock the Potential of the Eyes as the Ultimate Interface with Metaverse Shao-Yi Chien (Canzin Technology)	
	Color Reproduction Technology for Art Collection Market Jennifer Chen (Zhenyin Art)	
	PerectCorp AR: Virtual Try On for Makeover, Eyewear and Jewelry Johnny Tseng (Cyberlink/Perfect Corp.)	
	AQCOLOR Technology Chris Bai (BenQ Corporation)	

Track A Track B Track C

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9:40–10:10	Keynote 4 Color in Restoration and Conservation Work of Art, Dr. Pichayada Katemake		
10:10	Short Break		
10:20–11:00	Keynote 5 Color and Texture in 3D Prof. Tzung-Han Lin		
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11:10–12:10	Oral Session 5 Color Psychology	Oral Session 6 Color Technology	
12:10–13:30	Long Break		
13:30–14:30	Oral Session 7 Color Education & Color Therapy		
14:30–14:50	Short Break		
14:50–16:30	Poster Session 1 Color Vision	Poster Session 2 Color Application	Poster Session 3 Color Technology
16:30–16:40	Closing Ceremony		

October 20 (Thu.)

Opening Ceremony (9:00-9:10, Track A) General Chair: Tien-Rein Lee		

Keynotes (9:10-10:40, Track A) Chair: Tien-Rein Lee		
K1	Explore the Color in VR: from Chalkroom to Samsara	Hsin-Chien Huang (Storynest Narrative Lab, TW)
	Short Break (9:50-10:00)	
K2	Challenges and Opportunities in Color Science Introduced by Metaverse	Min-Chen Wei (The Hong Kong Polytechnic University, HK)

1. Color Vision (10:50-11:50, Track A) Chair: Yoko Mizokami and Hung-Shing Chen		
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S1-2	Color Dependency of the Pupillary Light Reflex Caused by Light Stimulation to the Blind	Marina Saito, Kentaro Miyamoto and Ikuya Murakami (JP)
S1-3	Testing Lightness Constancy in a Virtual Environment Presented by a Head-mounted Display (HMD)	Ichiro Kuriki, Kazuki Sato and Satoshi Shioiri (JP)
S1-4	Colour Appearance under Complex Illumination Conditions in a Virtual Environment	Li-Chen Ou and Ching-Ching Wu (TW)

2. Color in Art & Design (10:50-11:50, Track B) Chair: Cheng-Min Tsai		
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S2-2	Towards Color Extraction Methods in Color Planning Design for Place Branding	Tsuei-Ju Hsieh, Yi-Jung Chien, Yu-Chen Cheng, Ru-Jun Sun, Yao-Qi Wang (TW)
S2-3	A Pilot Study on the Color Recognition of Mobile Payment on User Interface	Cai-Syuan Lin and Wen-Yuan Lee (TW)

Long Break (11:50-13:30)		

3. Color Management (13:30-14:45, Track A) Chair: James Shyu and Yu-Ping Lan		
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S3-2	Lighting Simulation of Non-contact 2D Color and Gloss Measuring System Using Dome Illumination	Ayumu Kinugawa, Hiroyuki Iyota, Shimpei Fukagawa, Hayato Masuda and Hideki Sakai (JP)
S3-3	Reflected Glare Measurement of Object Colors Using a 2D Image Sensor	Shao Tang Hung, Hung Shing Chen, Pei Li Sun, Jui Chang Chiang and Bao Jen Pong (TW)
S3-4	A Method of Applying Incomplete Chromatic Adaptation in Colour Management	Phil Green (NO)
S3-5	The Level of Industry Preference Related to the Sensory Quality Evaluation on Color Infusion of Black Tea and Green Tea	Megita Ryanjani Tanuputri, Adi Djoko Guritno and Novita Erma Kristanti (ID)

4. Color & Culture (13:30-14:45, Track B) Chair: Li-Chen Ou		
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S4-2	Characteristics of Color Terms Underlying the Contemporary Japanese Aesthetic Senses	Kohji Yoshimura, Yuko Yamada and Stephen Shrader (JP)
S4-3	Acceptability Colour Ranges and Taste Expectations of Thai Milk Tea	Suchitra Sueeprasan, Kochaporn Supasiriate and Tisawan Chomfuangkaew (TH)
S4-4	A Study on Color Combination of Taiwan National Craft Brand	Suchitra Sueeprasan, Kochaporn Supasiriate and Tisawan Chomfuangkaew (TH) Yu-Zhen Wu and Chi-Seng Hung (TW)
S4-5	Color Tracking During Tea Processing: From Withering to Serving Process	Shafira Wuryandani, Nafis Khuriyati and Anggoro Cahyo Sukartiko (ID)

Short Break (14:45-15:00)

Special Session: Color for Future (15:00-16:40, Track A) Chair: Tsuei-Ju Hsieh		
1	Transforming Cultural Relics into Interactive Multimedia through Color Design	Tony Liu (Bright Ideas Design)
2	Unlock the Potential of the Eyes as the Ultimate Interface with Metaverse	Shao-Yi Chien (Canzin Technology)
3	Color Reproduction Technology for Art Collection Market	Jennifer Chen (Zhenyin Art)
4	PerectCorp AR: Virtual Try On for Makeover, Eyewear and Jewelry	Johnny Tseng (Cyberlink/Perfect Corp.)
5	AQCOLOR Technology	Chris Bai (BenQ Corporation)

October 21 (Fri.)

	Keynotes (9:00-11:00, Track A) Chair: Tien-Rein Lee	
K3	Interactive Color Tools for Creativity and AI	Masha Shugrina (NVIDIA Toronto AI Lab, CA)
K4	Color in Restoration and Conservation Work of Art	Pichayada Katemake (Chulalongkorn University, TH)
	Short Break (10:10-10:20)	
K5	Challenges and Opportunities in Color Science Introduced by Metaverse	Min-Chen Wei (The Hong Kong Polytechnic University, HK)

	5. Color Psychology (11:10-12:10, Track A) Chair: Miyoshi Ayama	
S5-1	Perception of Facial Brightness for Melanin and Hemoglobin changes	Takahisa Kitano, Hiromi Sato and Yoko Mizokami (JP)
S5-2	Expression of Impression Words with Color	Tadayuki Wakata, Kensuke Nojiri and Nana Kudo (JP)
S5-3	Using Coloured Paper to Increase Memory Retention: A study on Chroma	Suchitra Sueeprasan and Ormchai Bugsabong (TH)
S5-4	An Experimental Research on Color Afterimage	Ching Wei Peng, Vincent Sun and Ming Chuan Fu (TW)

	6. Color Technology (11:10-12:10, Track B) Chair: I-Ping Chen	
S6-1	Automatic Colorization of Grayscale Landscape Images based on Convolutional Neural Network	Jie-Sen Wang and Pei-Li Sun (TW)
S6-2	Research of Pseudo Color Rendering for Infrared Images	Cheng-Chuan Hsu, Yi-Ting Huang, Yung-Jhe Yan, Meng-Hsin Hsiao and Mang Ou-Yang (TW)
S6-3	Classification of Rice Grain Images by Machine Learning Techniques	Areerat Pathomchaiwal, Amarin Wongsetti and Saravudh Varasumanta (TH)
S6-4	Optimization of the Tea Leaf Fermentation Process Related to the Color of the Black Tea	Rosa Amalia, Rendayu Jonda Neisyafitri and Adi Djoko Guritno (ID)

Long Break (12:10-13:30)

	7. Color Education & Color Therapy (13:30-14:30, Track A) Chair: Yu-Ching Chen	
S7-1	Development and Evaluation of a Color Scheme Training Application for Digital Devices in Color Education	Daisuke Kasai, Takaki Orito, Aya Ono and Shigeomi Koshimizua (JP)
S7-2	Lighting Simulation of Non-contact 2D Color and Gloss Measuring System Using Dome Illumination	Tsukasa Muraya, Hikari Hamasaki, Momoka Nagatomi, Reina Chikara, Takuya Harada and Shoji Sunaga (JP)
S7-3	The Effect of Using Immersive Virtual Reality on Color Learning	Yu-ching Chen and Tsuei-Ju Hsieh (TW)
S7-4	Effect of quality of natural color and ingredients on Anthroposophy Art therapy	Nam-oi Saihoo (TH)

Short Break (14:30-14:50)

Poster Session 1. Color Vision (14:50-16:30, Track A) Chair: Ichiro Kuriki and Suchitra Sueeprasan		
P1-1	Investigation of Visual Color Perception in Cosmetics Using Standard Light Sources	Hung-Chung Li, Zhi-Jia Yang, Chun-Ya Yang, Ting-Yu Chao, Ting-Ning Yang, and ShihCing Li (TW)
P1-2	Effects of Dynamic Light on Slow-wave Sleep and Memory	Yi-Sheng Chen, Hung-Wei Chen, Yu-Sheng Chen, Ya-Chuan Huang, Chien-Ming Yang, and Chien-Yu Chen (TW)
P1-3	Initial Study of the Effects of Chromatic Light with Controlled Spectral Distribution on Creativity and Alertness	Takuma Hashimoto, Masatoshi Ishigane, Kota Shiono and Hiroshi Takahashi (JP)
P1-4	Establish 3-D Perceived Warmth Map of the Munsell Color System	Mutzu Kuo and Hung-Shing Chen (TW)
P1-5	The Effects of Wearing Special Glasses that Attenuate Light with Wavelengths Around 585 nm on Color Perception	Megumi Nishikawa and Akiyoshi Kitaoka (JP)
P1-6	Color Matching Experiment for Moving Point Light Source	Megumi Nishikawa and Akiyoshi Kitaoka (JP)
P1-7	Color-Sound Crossmodal Interaction using Stroop-like Paradigm	Kenta Miyamoto, Yuma Taniyama, Kyoko Hine and Shigeki Nakauchi (JP)
P1-8	Relationship Between Brightness Perception and Photoreceptor Stimulations Including Melanopsin	Aoi Takasu and Sei-Ichi Tsujimura (JP)
P1-9	A Study on Color Sorting by using the Farnsworth Munsell 100 Hue Test	Stanzin Wangmo and Cheng-Min Tsai (TW)
P1-10	The Relationship between the Steady-state Pupil Response and Brightness Sensitivity Obtained by Direct Heterochromatic Brightness Matching Based on Melanopsin Stimulation	Tomoe Ito and Sei-Ichi Tsujimura (JP)
P1-11	Perceptual Alternation in Colored Switching Glare Illusion	Risa Yamagata and Kazuho Fukuda (JP)

Poster Session 2. Color Application (14:50-16:30, Track B) Chair: Chanprapha Phuangsuwan and Tsuei-Ju Hsieh		
P2-1	Liberation of Color: The Color Theory of Kandinsky	Feiman Chang
P2-2	Exploring the Color Harmony of Digital Photography Works Based on Color Language Theory: A Case Study of Finalists' Works in the 2022 Taiwan Photo Contest	Yu-Chun Yao and Shiu-Hua Wu
P2-3	The Case Study of Background Colors for Organic Rice Production Media	Supannika Yongsue and Kamron Yongsue
P2-4	The Effects of Font-Color Combination on Consumer Perception of Products Packaging	Yu-Hsiang Chiu and Tsuei-Ju Hsieh (TW)
P2-5	Creating Interactive Media to Train Short-term Memory Skills in Children with Down Syndrome	Chirapong Yanuchit, Natakorn Kongthong and Pasavee Liewudomsinchai (TH)
P2-6	The Effect of Background Color on Sushi Advertisement Attitudes and Preference on Facebook	Natchaphak Meeusah, Chanida Saksirikosol, Kitirochna Rattanakasamsuk and Chanprapha Phuangsuwan (TH)
P2-7	Color Evaluation in Botanical Printing on Wool Fabrc Using Teak Leaves With and Without Mordants	Hsiu-Hua Hsieh and Cheng-Min Tsai (TW)
P2-8	A Comparison between the Perception of the Virtual Tour Media on the Internet Network and the Real Site Visit in Academic Place	Thanaphumi Songthanapithak and Nawapat Karaket (TH)
P2-9	Thai Flower Aroma and Basic Color Name	Chanida Saksirikosol, Chanprapha Phuangsuwan and Kitirochna Rattanakasamsuk (TH)
P2-10	A Pilot Study on the Relationship between Avatar Appearance and Personality Traits	Hsuan-Hsaun Chen and Wen-Yuan Lee (TW)

Poster Session 3. Color Technology (14:50-16:30, Track C) Chair: Pei-Li Sun		
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P3-2	Color Characteristics of the High-Dynamic Range Micro-Imaging System	Bao-Jen Pong, Shao-Tang Hung, Li-Wei Wen and Chao-Hua Wen (TW)
P3-3	Detecting and Following an Indoor Targeted Subject with Devised Flattery	Mei-Chun Lo, Jin-Ling Lin and Yi-Chin Chen (TW)
P3-4	A Study of Wet-to-Dry Variation with ISO International Standard.	Cheng-Jung Lin, Meng-Tsung Tai and Jia-Shan Wu (TW)
P3-5	Factors Affecting Accuracy of Camera-based Color Measurement using a Reference Color Chart	Kai-June Xu, Pei-Li Sun, Raymond Chiang and Fu-Ling Chang (TW)
P3-6	A Print Quality Study of ISO 15339 Implementation	Meng-Tsung Tai (TW)
P3-7	Enhance Color Density and Digital Watermark Gradation with Multi-Level Intaglio	Raymond Chiang and Pei-Li Sun (TW)
P3-8	Non-Destructive Determination of Photosynthetic Pigments in Leaves based on Color Mixture Theory	Yuan-Tzu Ou-Yang (TW)

Closing Ceremony (16:30-16:40, Track A) General Chair: Tien-Rein Lee

KEYNOTE SPEAKERS

EXPLORE THE COLOR IN VR: FROM CHAKKROOM TO SAMSARA

Hsin-Chien Huang

Biography

Hsin-Chien Huang is an artist, director in mixed media area. Science, technology, new media, programming, and algorithms are tools he uses to bring the universe of his imagination to life. He served as artistic director for SEGA and Sony. Huang collaborated with pioneering American media artist Laurie Anderson and their VR work La Camera Insabbiata/ Chalkroom which won the Best VR experience Award at the 74th Venice International Film Festival (it was the first edition of the festival that introduced its virtual-reality section); his work Bodyless was also nominated in the 76th of the festival. In 2011, Huang received by president of Taiwan Ma Ying-jeou and granted as one of the "Pride of Taiwan" honor. He founded Storynest Studio after 2001, which engaged in artistic creation and commercial design. Huang is currently a distinguished professor at National Taiwan Normal University.

Currently, his Samsara has selected to win the Jury Award in 2021 Texas SXSW Festival.

http://hsinchienhuang.com/1_news.php?lang=en

Abstract

In this keynote, award-winning VR director Hsin-Chien Huang shares his process of virtual reality creation. He will talk about the development of colors and forms in immersive content.

CHALLENGES AND OPPORTUNITIES IN COLOR SCIENCE INTRODUCED BY METAVERSE

Dr. Minchen Wei

Biography

Minchen Wei obtained his Bachelor degree from Fudan University in 2009. In Aug 2011 and Dec 2015, he earned his Master of Science and PhD degrees in Architectural Engineering at The Pennsylvania State University. He joined The Hong Kong Polytechnic University in Oct 2015 as an Assistant Professor and was promoted to Associate Professor in 2020. His research mainly focuses on fundamental color science, color management and application for imaging and metaverse systems (e.g., display, camera, AR/VR/MR), and illuminating engineering. His work has been supported by the Research Grant Council (RGC) of Hong Kong, National Science Foundation of China (NSFC), Hong Kong Policy Innovation and Coordination Office, and Hong Kong SAR Electrical and Mechanical Services Department (EMSD), and various industry partners (i.e., Facebook, Google, Huawei, DJI, WSP, OPPO, OPPLE Lighting, etc). Dr. Wei is currently the Vice Chairman of CIE (HK), and Hong Kong's representative in CIE Division 1 and 8. He is also an Associate Editor of Journal of the Optical Society of America A, and Color Research & Application. In 2021, he received a Google Research Scholar Award.

Abstract

Color science research generally investigate how the human visual system responds to optical radiation produced by various sources and systems. The research findings help to develop metrics, models, formula, and thresholds, which are used for color measurement, specification, calibration, and processing. The appearance of various new imaging systems in metaverse introduces both challenges and opportunities, since the viewing conditions provided by these metaverse systems are completely different from the conventional applications. For example, most existing models were developed for applications related to surface colors (e.g., printing, fabric, textile, painting) or self-luminous colors (e.g., light sources and displays). In contrast, the imaging systems in metaverse provides much larger field of view than typical displays, which makes the viewing conditions more similar to the real conditions. This talk reports several of the research work that has been carried out in our laboratory. This research has revealed the necessity to specifically focus on these new systems, and to develop new models for these systems.

INTERACTIVE COLOR TOOLS FOR CREATIVITY AND AI

Dr. Masha Shugrina

Biography

Masha Shugrina is a Senior Research Scientist at the NVIDIA Toronto AI Lab, where she manages a group focused on creative applications of AI and efforts to accelerate research. Masha defended her PhD at the University of Toronto, where she investigated the design playful and intelligent creative tools, receiving Canada's Alain Fournier Award for Outstanding Doctoral Dissertation in Computer Graphics and founding colorsandbox.com. Prior to this, she was a Research Engineer at Adobe Research (Cambridge, MA), where she led the Playful Palette project. Before Adobe, Masha got her Master's in Computer Science from MIT, and before that she was a Senior Software Engineer / Tech Lead at Google (NYC and Zurich). She is also an avid oil painter, whenever she can find the time.

Abstract

Color is a core aspect of many visual fields, and digital interfaces for working with color have a big effect on the creative process. In this talk, I will present several case studies in designing interactive tools for working with color by focusing on artists' needs, functionality as well as playfulness and enjoyment. Specifically, I will examine the domain of digital painting, and then broaden the context to consider color use cases across a variety of domains. In the second part of the talk I will describe the color triad representation that can model color distributions of existing images and allow interactive color exploration. Finally, I will show an application of this representation from the field of generative adversarial networks (GANs) for modeling interactive drawing media. The talk will conclude with some design principles for color interfaces with the creative process in mind.

COLOR IN RESTORATION AND CONSERVATION WORK OF ART

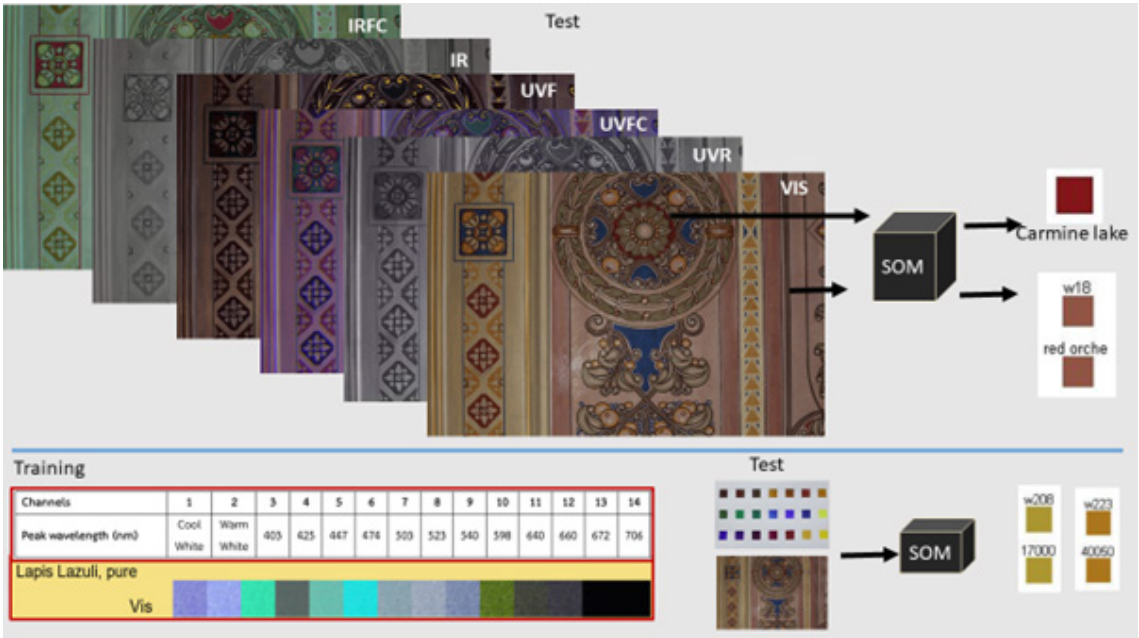
Dr. Pichayada Katemake

Biography

Dr. Pichayada Katemake is an associated professor of Faculty of Science, Chulalongkorn University, Thailand, teaching and doing research in the field of color physics, color science and related fields in the Department of Imaging and Printing Technology. She has been doing the research on the perception of the low vision for more than 10 years. She is interested in use of high quality illumination to enhance the perception. She determines to develop the protocols for Thai arts conservation and restoration using science and technology.

Abstract

Identifying pigments used in the work of art is an important process in restoration and conservation. Hyperspectral and Multispectral imaging are employed widely for this purpose. My talk includes the use of a series of images obtained from multi-spectral imaging based on technical photography with UV-Vis-NIR and on 14-channels of narrow-band LEDs as training sets for classifying and identifying pigments. Applying an unsupervised learning algorithm, Self Organize Maps (SOM) is mentioned.



COLOR AND TEXTURE IN 3D SHAPE MEASUREMENT

Prof. Tzung-Han Lin

Biography

Dr. Tzung-Han Lin is a Professor at the Graduate Institute of Colour and Illumination Technology, National Taiwan University of Science and Technology (NTUST), Taiwan.

Dr. Lin received a Ph.D. of Mechanical Engineering from National Taiwan University, Taiwan in 2006. He joined Industrial Technology and Research Institute (ITRI) as a senior engineer in 2007. He was a visiting scholar of Carnegie Mellon University in 2007 and 2008. Since 2011, he has been with NTUST, where he is currently a Professor. He served as a technical consultant of Etron Inc. during 2015-2017. In 2020, Dr. Lin also received outstanding research award from NTUST.

His research interest includes Physically based rendering (PBR) texture, 3D color imaging, 3D Scanning technology, 3D data processing, Computer graphics, Computer vision and 3D printing related topics. He published 80+ peer-reviewed papers and 25+ worldwide patents. Based on his numerous research projects, he also promoted several successful commercial products to the market particularly in 3D and color measurement field.

Abstract

3D shape measurement is the technology to collect not only 3D geometry information but color appearance. However, there are few commercial products which are able to reproduce accurate color and texture for 3D objects. To visualize a realistic 3D object, physically based rendering (PBR) texture is usually used. In PBR texture, there are several factors such as diffusion, glossy, roughness, metallic, surface normal et. al. In this talk, I will introduce to how a 3D scanning device was developed, and why PBR is important and difficult to obtain in 3D shape measurement. In recent decade, we dedicated on the development of 3D shape measurement for various industrial applications. It is no doubt that "color" as well as texture is the most critical part for visualization in digital age. For different purposes, we developed several types of 3D appearance measurement devices based on different configurations. Most of them were practical and designed to severe the need of 3D color measurement. Moreover, this talk will provide the perspective view from 3D engineering to understand the fundamentals of "color and texture".

ORAL SESSIONS

Session 1 Color Vision

Session 2 Color in Art & Design

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ORAL

SESSION 1

COLOR VISION

PERCEPTUAL COLOR DIFFERENCE AND CATEGORICAL COLOR PERCEPTION OF COLOR VISION DEFICIENCY WITH COLOR CORRECTING GLASSES

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ABSTRACT

There is various strength of color vision deficiency (CVD). It has been considered that anomalous trichromats possess longer or shorter wavelength-shifted photopigments instead of normal L- or M- photopigments. The amount of the shift would be one of the reasons for the variety. Color-correcting glasses have been developed to help people with CVD to discriminate colors. However, it has not been well evaluated how effective the glasses are and how color perception changes when wearing them. This study investigated the effectiveness of color-correcting glasses by comparing the perceptual color difference and categorical color perception of CVD with and without color-correcting glasses. We also investigated whether the cone sensitivity-shift model developed by Yaguchi et al. (2018), which assumes spectral sensitivity shifts in the L and M cones of the color vision deficiencies, can predict perceptual color differences of CVD. We conducted experiments to evaluate the color difference of color-patch pairs and to categorize color patches by color names under white illumination with a correlated color temperature of 5000 K. Eleven protan or deutan observers participated. The stimuli for evaluating the color difference were twenty-five color-patch pairs with different degrees of discrimination difficulty. Observers rated the color difference of each pair using a 7-point grayscale. As a result, the discriminability of some color-patch pairs was improved using color-correcting glasses. However, others were not, suggesting that considering the reflectance of patches, the transmittance of glasses, cone sensitivity, and their combination is important. The score results were compared with chromaticity, luminance, and color difference for color-deficient observers calculated based on the cone sensitivity-shift model. The evaluation data showed the highest correlation with the chromaticity difference, whereas it showed little correlation with luminance and color difference. This suggests that the chromaticity differences based on the cone-shift model are the best predictors of CVD color discrimination. The stimuli for categorical color naming were 109 color patches covering various hues, values, and chromas. Observers were shown all patches simultaneously and categorized color patches by 11 basic color names. As a result, CVD observers with color-correcting glasses categorized fewer color chips as red and more color chips as brown than the naked eye, indicating that color-correcting glasses affected categorical color perception. Our results suggest that color-correcting glasses could be expected to improve specific perceptual color differences but not categorical color perception.

Keywords: Color vision deficiency, Color difference, Categorical color perception, Cone sensitivity-shift model

COLOR DEPENDENCY OF THE PUPILLARY LIGHT REFLEX CAUSED BY LIGHT STIMULATION TO THE BLIND SPOT

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ABSTRACT

The natural blind spot corresponds to an ocular region called the optic disk, which consists of blood vessels and the axons of retinal ganglion cells and contains no classical photoreceptors, rods and cones. However, our previous studies have shown that light stimulation inside the blind spot enhances the pupillary light reflex and changes the brightness perception outside the blind spot. These findings indicate that there is a mechanism of photoreception for stimuli presented within the blind spot. One possible candidate of the mechanism is scattering of the light stimulus delivered to the blind spot. Even if the light input is only targeted to the blind spot, the light input to the eye is scattered and reflected without exception. Another explanation is photoreception by melanopsin, which is a kind of photopigment existing in the optic disk, along the axons of intrinsically photosensitive retinal ganglion cells. The purpose of this study was to further investigate the mechanism of photoreception for stimuli presented within the blind spot by comparing the amounts of the pupillary light reflex that occurred when red and blue light stimuli were used as blind spot stimulation. We used red and blue light stimuli whose luminance values were calibrated so as to produce the same amount of pupillary light reflex if presented within a normal peripheral visual field of the same eccentricity as that of the blind spot. These stimuli were presented within the blind spot, and the amount of pupillary light reflex evoked from each of the color stimuli was recorded by a video-based eye tracker. The results demonstrated pupillary light reflex evoked from both stimuli, but the amount of pupillary light reflex with the blue stimulus was significantly larger than that with the red one. Since the pupillary light reflex occurred even with the red stimulus, whose wavelength spectra were far from the spectral peak of melanopsin's absorbance sensitivity, not the photoreception by melanopsin but some other processes, such as the involvement of the classical photoreceptors detecting some scattering light, might be the source of the pupillary light reflex. On the other hand, the larger pupil contraction with the blue stimulus suggests that the pupillary light reflex triggered by some mechanism involving classical photoreceptors was enhanced by melanopsin activation. These results indicate that two mechanisms, classical photoreception and melanopsin activation, are involved in the pupillary light reflex triggered by light stimulation targeted to the blind spot.

Keywords: Natural blind spot, Optic disk, Melanopsin, Pupillary light reflex, Pupil

TESTING LIGHTNESS CONSTANCY IN A VIRTUAL ENVIRONMENT PRESENTED BY A HEAD-MOUNTED DISPLAY (HMD)

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ABSTRACT

Head mounted displays (HMDs) are getting more and more popular as a device to display virtual environments and objects. We examined how lightness perception (i.e., perceived surface reflectance) can be properly achieved from images on the screen of HMDs by using the constancy of lightness perception as an index. We simulated an ambiently illuminated room, which was furnished with achromatic walls and objects, in a Oculus Rift DK2 HMD, equipped with an OLED panel. The walls of the room were articulated with achromatic tiles. To measure the lightness constancy, another illuminated environment was presented in a viewing box placed in the virtual room, in which a test stimulus was presented. Participants (N = 10) were asked to look into the viewing box to examine the lightness of the test stimulus (an achromatic square) and to adjust the luminance of a matching stimulus (another achromatic square) in the virtual room to match the lightness of both stimuli. There were five conditions of illuminant-intensity ratios between the inside and outside of the viewing box; 1: 4, 1: 2, 1:1, 2: 1, and 4: 1. There were five levels for the test stimulus, which was chosen equally on a logluminance scale. The result was evaluated by Brunswik ratio (BR); this index represents a percentile of lightness constancy, derived from the luminance shift of matched result as a portion of expected shift under perfect constancy (see Foster (2011) for a review). As a result, the BRs were slightly different among illuminant-intensity ratio conditions, but are significantly higher than the average of previous lightness constancy studies conducted on computer screens (around 65% on average; [1]), while the lowest BR in our results was 74.2+/-6.3% (mean+/-SD across conditions). The previous studies using real objects yielded higher BRs than those using computer screen, in general, and were about 80% on average [1], whereas the highest BR in our result was 84.8+/-14.5%. To confirm the effect of head tracking ability of HMDs, we conducted additional experiments by disabling the head tracking ability or showing replay of scenes generated by prerecorded trajectories of head motion. The absence of head tracking yielded lower BRs (60.9%), indicating that the head tracking feature was very important for the achievement of lightness constancy in the virtual environment. However, the BRs did not differ significantly between whether the motion of scenes viewed in the HMD was generated by spontaneous motion or replay. This tendency is in line with a previous study suggesting that the use of moving stimuli yielded higher BRs. In summary, the virtual illuminated environment in a HMD yielded as good lightness perception as the scenes using actual objects, especially when it allows participants to look around the scene.

Keywords: lightness perception; lightness constancy; virtual reality; head mounted display; HMD

THE EFFECTS OF WEARING SPECIAL GLASSES THAT ATTENUATE LIGHT WITH WAVELENGTHS AROUND 585 NM ON COLOR PERCEPTION

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ABSTRACT

We investigated the effects of wearing special glasses (NeoContrast, Mitsui Chemicals) that attenuate light with wavelengths around 585 nm on color perception. Previous studies reported that these glasses increased contrast sensitivity [1] and made red and green colors appear more vivid [2]. However, the effects on other colors have not been examined yet. Therefore, we examined the effects of wearing these glasses on the color perception of a wide range of hues using the Munsell color chart. Experiment 1 examined the effect of wearing these glasses on chromatic colors. Ten adults (6 females, 4 males; ages 21–30 years, mean age = 24.7 years) participated, and no one reported to have color vision deficiency. They observed Munsell color charts with and without these glasses. As a result, these glasses made all colors appear more vivid. Experiment 2 examined the effect of wearing these glasses on achromatic colors. Four adults (3 females, 1 male; ages 23–26 years, mean age = 24.5 years) participated, and they also participated in Experiment 1. They observed color charts with and without these glasses as in Experiment 1. As a result, there was no appearance of color on achromatic charts. Experiment 3 investigated the effects of visual adaptation after wearing these glasses. Ten adults (6 females, 4 males; ages 21–27 years, mean age = 24.0 years) participated. No one reported to have color vision deficiency, and they did not participate in Experiment 1 and 2. They rated vividness, beauty, preference and attractiveness of color charts immediately after wearing these glasses, 5, 10, 15, or 30 minutes later. The results showed that the ratings did not change significantly up to 30 minutes after wearing these glasses. In conclusion, these glasses made a variety of colors more vivid and there was no adaptive change in this effect.

Keywords: Color perception, Special glasses, Light with wavelengths around 585 nm, Vividness

ORAL

SESSION 2

Color in Art & Design

MEASUREMENT OF THE CONTRAST IMPACT OF PATTERNED BLOUSE AND SINGLE-COLOR SKIRT COMBINATION

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ABSTRACT

In everyday life, many people wear upper and lower garments, for example, a combination of blouse and skirt, or shirt and pants, rather than a dress or a jumpsuit. In such combination style, color scheme is an important factor, and thus various studies have been conducted on the relation between color scheme and emotion or impression. However, people often wear patterned cloths in the top or bottom, or sometimes both. We consider that people judge some kind of "contrast" between upper and lower garments regardless of whether the clothes are single color or patterned, and decide the coordination that fits to the TPO (Time, Place, and Occasion) or his/her mood of the day.

In this study, we call the subjective strength of contrast between upper and lower garment "contrast impact". If such a "contrast impact" concept is expressed by some function of colorimetric values regardless of patterned or single-color clothes, and its relation to sensibility words is explored, it will be useful for fashion analysis and recommendation. Therefore, we tried to scale the "contrast impact" of patterned blouse and single-color skirt combinations (test stimuli) by comparing the strength of contrast impression with that of the reference stimuli which is a series of achromatic combination of the same style such as white blouse and gray skirt, or gray blouse and black skirt, etc. Furthermore, to investigate the relation between contrast impact and total impression of the clothes, subjective evaluation of sensibility words was conducted for the test stimuli.

In the experiment, 60 test stimuli made of real fabrics, were prepared. Flower pattern blouses of five colors (black, red, yellow, green, and blue) with 3 different sizes of pattern were combined with four different monochromatic skirts. Twelve reference stimuli of the same style, but the blouses and skirts were, white, light gray, medium gray, or black were also prepared. Each test stimulus was compared with one of the reference stimuli, and the observer was asked to answer which stimulus gives stronger contrast impression (pair comparison). After that, only a test stimulus was presented, and the observer was asked to do subjective evaluations for six words of "subdued", "pretty", "neat", "bright", "plain", and "showy" on a seven-point scale (from 0: not at all, to 6: very much). Eight young female observers participated the experiment.

Stable tendency was observed among observers in the measurement of contrast impact, implying that the judgement of subjective strength of contrast was possible. Results were well fitted by the modified luminance contrast between upper and lower garments of the reference stimuli ($r > 0.9$ for all test stimuli). In the results of subjective evaluation, results of black flower blouse showed relatively simple tendency, i.e., positive correlation with the contrast impact in the evaluation of "bright" and "showy". On the other hand, results of colored flower blouse were not simple, suggesting influence of saturation, pattern size, and color emotion. Quantitative relations between the rating of these evaluation words, contrast impact, and other factors will be investigated.

Keywords: fashion, color, contrast impact, luminance contrast, subjective evaluation

TOWARDS COLOR EXTRACTION METHODS IN COLOR PLANNING FOR PLACE BRANDING

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ABSTRACT

Place branding is based on the idea that cities and regions can be branded so that marketing promotion strategies can be applied. In recent years, place branding has become a rapidly growing field of study because of its role in regional revitalization. Color is a critical visible element in the work of place image orchestration, as it often serves as an essential element in planning the place-product packaging and advertising. It efficiently delivers a unified impression of a place brand by applying signature colors on relevant products and design works. To extract representative colors for place branding, two methods have been commonly employed, i.e., sampling the colors from representational objects such as cultural landmarks or specialty goods and averaging pixels of scenery photos taken in the region. However, there is still a lack of sufficient research to examine whether these methods are well-funded to capture regional spirits and features. In this study, we proposed modified ways that have been less considered in previous studies. We selected Hengshan township as a target of place branding to implement our methods. To understand color planning workflow in practice, we interviewed artists and designers whose recent works involve the Hengshan theme. Based on these color practitioners' experiences and expectations, two considerations for improving color extraction methods were implemented to establish a color palette for Hengshan. First, we surveyed representative objects found in Hengshan customs and culture and measured the surface colors with a spectrophotometer X-Rite i1 in CIE LAB color space. In addition, we analyzed the predicted visual attention distributed on regional scenery photos to improve the pixel averaging method in typical color extraction. We will select the averaged colors based on the density of visual attention. Following these procedures, we will develop a functional, meaningful, and beautiful Hengshan color palette for relevant designers and artists. The future direction of the study will focus on assessing the satisfaction of users/creators aided by the Hengshan color palette.

Keywords: place branding, placemaking, image orchestration, color palette, Hengshan

A PILOT STUDY ON THE COLOR RECOGNITION ON THE USER INTERFACES FOR MOBILE PAYMENT

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ABSTRACT

Mobile payments, also known as mobile money, mobile money transfers, or mobile wallets, are monetary payments for products or services made through a portable electronic device, rather than using cash, checks, or credit cards. Traditional payment methods are basically in the interaction of people-people, people-banks, people-business, etc. There exists basic trust in these interactions, such trust exists in the currency, banks, and the business activity. In the mobile payment system, what the user actually facing is the interface on the electronic device. We are curious to know whether users have trust in mobile payment and whether the interface design of mobile payment affects users' trust on mobile payment.

Among many design elements for interface design, color not only provide the aesthetic appearance but also provides the functions of information hierarchy, labeling, indexing, reminders, etc. Additionally, personalization is a key factor in designing interfaces for smartphones and other technologies. Specific user behavior, for example, changes on the springboard, bottom bar, lock screen can be used to identify the user level, assisting us to examine how user experience affects the trust in mobile payment. This pilot study intends to understand whether color cognition affects trust in the interface of mobile payment.

In order to see how color influences the trust in the interface of mobile payment, this study conducted an online questionnaire. This questionnaire included the interfaces with 5 colors, i.e., red, green, yellow, blue, and black colors to see which color interface the users chose in the mobile payment for the two transaction amounts of 1,000 NT dollars and 100,000 NT dollars?

A total of 33 participants took part, including 13 males and 20 females. The average age was 27.6 years old. Additionally, participants' basic information and user level took into account. The data obtained from the questionnaire showed that the most used App for participants to use mobile payment is Line Pay, followed by Apple Pay. The major reasons for using mobile payments are convenience, ease of use, and rewards. In the mobile payment experience of most participants, the maximum transaction amount is between 1,000 and 5,000 NT dollars. The initial results showed that (1) 94% of participants chose different colored interface in two transaction amounts, (2) the trusted interfaces which be the most chosen for transaction amounts less than 1,000 NT dollars is green, followed by blue, black colors, however, the color of the trusted interface above 100,000 NT dollars change to red color, (3) the participants sought convenience, ease of use, trustworthiness, and security for mobile payment interface with lower amounts, however, security becomes the primary requirement when the transaction amount above 100,000 NT dollars, (4) the advanced users

completely ignore the interface with red and yellow colors when the mobile payment is less than 1,000 NT dollars, and when the amount is higher, the red color interface is more acceptable. This implies that the transaction amount affects the user's requirements for the mobile payment interface.

Keywords: Mobile payment, User Interface, Color recognition

ORAL

SESSION 3

Color Management

CHICKEN COMB COLOR CALIBRATION CHECKER DESIGNED FOR MONITORING IN POULTRY HOUSE

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ABSTRACT

In recent years, remote management and monitoring environment of poultry house has become an important demand of animal husbandry. For poultry house management, the health status of each individual chicken is often difficult to be judged manually particularly for the situation of a large number of livestock. Therefore, there are many related researches based on computer vision system to identify poultry and livestock. However, there are few studies dedicating on systematical solution to analyze the color of living poultry. Before conducting this research, it is necessary to obtain the actual color of living poultry from the images of remote surveillance cameras. Due to constantly changing light and shadow in the poultry houses during the day, the colors in the captured images are often unstable, which makes it difficult to identify the correct information of living poultry. Therefore, it is necessary to carry out effective color calibration for the images taken by remote surveillance cameras in the poultry house. In this paper, a high order polynomial equation method is used due to its fast and effective features for color calibration, which requires several color reference samples to correct the image. In this study, we design a set of corrected color samples for broiler poultry house environment, including the main colors of chicken comb, poultry house internal structure and field equipment, etc.. The selected color samples are made into a new color checker board, which were used for color calibration of poultry house images and for comparison with the calibrated results of the Macbeth dataset. The results show that after color calibrations, the color difference has become lower than that of the Macbeth dataset, which resembles more actual color samples in the poultry house. This method makes it possible to monitor native chickens and would be helpful to identify the health status of chickens in poultry houses.

Keywords: Color checker design, Color calibration, Poultry surveillance, Chicken Comb

LIGHTING SIMULATION OF A NON-CONTACT 2D COLOR AND GLOSS MEASURING SYSTEM USING DOME ILLUMINATION

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ABSTRACT

The appearance of an object is significantly influenced by its color and glossiness. Particularly, it is known that the surface color and gloss of products, such as raw and processed foods and building materials, change depending on the amount and distribution of moisture near the surface. Therefore, quantifying the appearance that interacts with moisture plays an important role in quality control, as well as in process control for energy conservation and improving quality in the manufacturing aspect. However, conventional color and gloss measurement methods require contact with the object because they mainly target flat, patternless, monochromatic surfaces. Additionally, they can measure the color and gloss only at a single/spot location. In this study, we developed a dome-shaped illumination device that can quantitatively determine the color and glossiness of a sample in a twodimensional and non-contact manner using a digital camera. The system is capable of twodimensional, non-contact measurement of color and gloss on samples with complex surfaces and wet samples, which have been difficult to measure in the past. A digital camera, which resembles an integrating sphere is installed at the top of the dome, and a light shield (light trap) is installed in the upper half of the dome with a width of 30 degrees at 60-degree intervals. The specular component included (SCI) and excluded (SCE) are obtained from 12 images taken by the digital camera each time the light trap is rotated 30 degrees. The L*a*b* values of each pixel on the SCE image and gloss from the difference in brightness between the SCI and SCE are evaluated.

In this study, we performed computer lighting simulation to improve the theoretical background of this color and gloss measurement method. Radiance is used as lighting simulator for this study. We simulated the color image captured by the digital camera; subsequently, the color and gloss information were compared with this measuring system. A few types of objects with the sample geometry surface were used. The illumination environment inside the dome was also evaluated.

Keywords: color, glossiness, dome-shaped illumination device, lighting simulation

REFLECTED GLARE MEASUREMENT OF OBJECT COLORS USING A 2D IMAGE SENSOR

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ABSTRACT

This work investigates reflected glare and develops reflected glare profiles. Two types of miniaturized color charts, including matte and gloss gray patches, are chosen as the test colors. The test colors are fixed under the various illuminated conditions for generating reflected glare. For measuring reflected glare, a well-calibrated digital camera is set up to capture the images of the color samples. These images are transformed to calculate CIE UGR glare index. Besides, a Long Short- Term Memory (LSTM) network model is appended to create the predicting model for predicting the angle-dependent reflected luminance distributions.

Keywords: Reflected glare, Reflected luminance distribution

A METHOD OF APPLYING INCOMPLETE CHROMATIC ADAPTATION IN COLOUR MANAGEMENT

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ABSTRACT

Chromatic adaptation is an important and reasonably well-understood phenomenon, in which the human visual system adjusts cone responses in order to compensate for the colour of the illumination and thus preserve approximate colour constancy for objects in the field of view. The adapted white is a stimulus seen by an observer as being perfectly achromatic, and chromatic adaptation models predict the match to a given stimulus under a change in illuminant.

In colour management it is usually assumed that the observer is fully adapted to the white point of the imaging medium, i.e. the brightest achromatic colour that can be produced on that medium. When full adaptation is assumed, it is possible to simplify a chromatic adaptation model such that the different stages are concatenated, and this is done to derive the linear form of the Bradford chromatic adaptation model used to transform colorimetric data to and from the D50 ICC Profile Connection Space.

In practice adaptation to the imaging medium (or to a perfect reflecting diffuser, as in the case of the ICC-absolute colorimetric rendering intent) is frequently incomplete, and several studies have shown a degree of adaptation of approximately 60% to the imaging medium chromaticity.

In ICC.2, a mechanism for implementing partial adaptation in the colour management module (CMM) has been described. However, at present there is no mechanism to implement incomplete adaptation in a colour managed workflow in the more widely used ICC.1. In this paper a method is proposed, and it is also shown how the approach can also be used to implement an adjustment to compensate for the simultaneous contrast effect.

In an initial step, the imaging medium white point is taken as the source illuminant, and chromatically adapted to D50 using the full Bradford transform, and with the desired degree of adaptation. Next, this partially adapted white point is taken as the destination adopted white, and the linear Bradford transform is used to convert data before encoding in the profile. When applied in a colour management workflow, this results in a neutral scale which is visually achromatic, even on a coloured medium.

Keywords: Colour management, Incomplete chromatic adaptation

THE LEVEL OF INDUSTRY PREFERENCE RELATED TO THE SENSORY QUALITY EVALUATION ON COLOR INFUSION OF BLACK TEA AND GREEN TEA

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ABSTRACT

The global tea market is showing the growth in the last decade as annually increased by 3.6 percent to 6.1 million tonnes in 2020. This growing condition is expected to happen in the coming years as the market continues to be underpinned by the stringent and robust demand. Demand for green tea shows an increasing trend, while black tea continues to dominate the global market. Furthermore, the recent global condition as an impact of Covid-19 has also influenced the rapid change on the tea global market and buyer preferences especially from the tea industry. This condition thus has encouraged the more fierce competitiveness in the global market. On the other hand, the domestic tea market of Indonesia does not show massive growth and typically give uncompetitive prices for industry. As one of the main global producers of tea, Indonesia should be able to understand and accommodate market preference of black tea and green tea, both global and domestic market. The previous studies found that the good quality of black tea is also characterized by the color infusion, as a bright reddish-brown is more preferred. Some industrial buyers have also determined their specific preference on color infusion of tea for each of their target customers. Compared to traditional sensory quality evaluation by the expert panelist, color values evaluation are looked at as indicators to assess tea quality more objectively. Therefore, this study aims to understand the preference of buyers, specifically the tea industry, in the global and domestic tea market towards the infusion color of black tea and green tea by comparing the result of traditional sensory quality evaluation and color value evaluation. In total, ten grades of black tea quality and five grades of green tea quality were used as the sample on determining the preference of tea buyer from the global and domestic market. These samples were collected from a private-based tea industry based in Central Java Province, Indonesia. A chromameter (model Minolta CR 4-00, Konica Minolta Photo Imaging Ltd.) were used in this analysis to measure the color value of L*a*b*. By further analysis, this study revealed that there is a gap between the buyer preference and the quality of black tea produced by the Indonesian tea industry. It conveys that the Indonesian tea industry is still lacking the ability to follow the requirements from the buyer, especially for global buyers. In addition, there is a different preference between global and domestic buyers in terms of black tea color infusion. Similar results were also found in the green tea. This study further revealed that the sensory quality evaluation by expert panelists shows a different result from the color value evaluation.

Keywords: Black tea, Buyer preference, Colour infusion, Tea panellist, Tea quality

ORAL

SESSION 4

Color & Culture

DIFFERENCES IN COLOR RECOGNITION AND COLOR NAMES BY CHINESE CHARACTERS BETWEEN CHINA AND JAPAN

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ABSTRACT

Although kanji (hànzì or Chinese character) is commonly used in both China and Japan, numerous studies have shown differences in the perception of colors and color words. One notable difference between China and Japan is that the kanji " 紅 " (pronounced hóng in Chinese / koh in Japanese) is mainly used for red in China, while " 赤 " (chì / seki) is mainly used in Japan. Similarly, the kanji for blue is " 藍 " (lán / ran) in China and " 青 " (qīng / sei) in Japan. To analyze the differences in the relationship between kanjis and colors between Japan and China, we presented red and blue color samples of various brightness and saturation levels to Japanese respondents, Chinese respondents living in Japan, and Chinese respondents living in China (mainland). We asked them to choose a color sample associated with the characters.

The experimental results showed that the saturation of the colors associated with " 紅／赤 " and " 藍／青 " differed between the Japanese and Chinese. Specifically, for saturation combinations selected for the " 紅 ／ 赤 ", Chinese living in both countries tended to answer that " 紅 " is more saturated than " 赤 ". In contrast, the Japanese tended to answer that " 紅 " is less saturated than " 赤 ". For the saturation combination selected for " 藍／青 ", Chinese living in both countries tended to answer that "藍" is more saturated than "青", and Japanese tended to answer that "藍" is less saturated than "青".

Keywords: color names, Chinese characters, Red, Blue, China and Japan

CHARACTERISTICS OF COLOR TERMS UNDERLYING THE CONTEMPORARY JAPANESE AESTHETIC SENSES

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ABSTRACT

The Japanese sense of beauty has long reflected a variety of aesthetic senses such as wabi, sabi, yugen (literally 'the beginning of the afterlife': subtle profoundness), miyabi (urban elegance), iki (a rich spirit of playfulness), ma (an awareness of the value of the empty space between things), anji (suggestion; implied meaning), asymmetry, and simplicity (or brevity). These values are reflected in the 2021 restoration of the vermillion columns at the southern gate and the restored Toin Garden of the Heijo Palace in Nara Prefecture. The tradition of cherishing beauty in Japan has been passed down through the ages. Japanese artists are known for being skilled at making the incomplete or seemingly ugly into an embodiment of beauty. We would like to show contemporary Japanese aesthetic values as revealed in the coloration of tamba-yaki pottery (earthenware from Hyogo Prefecture), the traditional ceremonial procession at Heijo Palace, and the colors of the Hankyu Railways train cars.

In the case of the train cars produced by the Hankyu Railway Company, since its establishment in 1910 they have been using a color called "Hankyu maroon." It is so named because it looks like the burnt brown color of the chestnut shell. This color is less like chestnut and more like the color of chocolate and azuki beans, which are slightly darker. On the Munsell

Chart it appears as 5R 1.5/4.7, and in RGB it is designated as 69, 23, 34. This maroon has a glossiness and depth to it, and its beauty is well-known as being dignified and refined. Around the areas serviced by the Hankyu Railway maroon elementary school backpacks (randoseru) are sold, and Volkswagen collaborates with them in producing cars with this color.

Wabi and sabi are aesthetics that find beauty in the imperfect, the fleeting, and in simplicity. However, these aesthetic sensibilities also put value on functional beauty. Japanese houses have both the beauty of simplicity and beauty through decoration. In this way we can see that the Japanese sense of beauty includes the special characteristic of holding two different and contrasting elements as coexisting with equal importance. This is to say, there is an ability to value what might seem to be conflicting elements as working together in a positive way. This concept is expressed in Japanese as ryomen-kachi-sei (**両面価値性**), which is often translated as ambivalence but does not have any negative connotation in Japanese. This reflects a "culture of inclusion" in Japanese culture, or an acceptance of diversity. As modern Japan's population is decreasing there are efforts being made to bring people together by valuing the culture of different local areas (both locally and globally). Since around 2010 companies have started to produce everyday products in Japan such as rice cookers,

refrigerators, and school bags in a wider variety of bright colors. At the same time, many Japanese consumers continue to love muted colors and austerely elegant colors which are suited to the calm landscape and atmosphere of traditional Japan.

Keywords: Japanese aesthetic senses, Color terms, Tamba-yaki pottery, Hankyu maroon, Culture of inclusion

ACCEPTABILITY COLOUR RANGES AND TASTE EXPECTATIONS OF THAI MILK TEA

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ABSTRACT

This study aimed to determine the acceptability colour ranges of Thai milk tea and expectations in taste. Firstly, we surveyed the colours of Thai milk tea products readily found in the market. Fifteen colour samples were then prepared to cover the colour range of the Thai milk tea products. The colour samples were made by adjusting the amounts of instant Thai milk tea powder, water, milk, and food colouring. Each sample was presented to observers in a transparent plastic cup placed in a light booth illuminated with D65 simulators. Thirty normal colour-vision observers between 18 and 25 years of age took part in the experiments. Each observer assessed one sample at a time in a random order. Their tasks were to rate the colour samples in terms of acceptability, preference, and expectations in taste for sweetness, bitterness, and mellowness. They gave a score from 1 (the least) to 5 (the most), where 3 represented the midpoint between negative (e.g. unacceptable) and positive (e.g. acceptable). It was found that the acceptable hue of Thai milk tea was reddish orange, with moderate to high lightness and low to moderate chroma. The results of acceptability and preference were highly correlated. Sweetness had a positive correlation with redness (a*). Bitterness inversely correlated with lightness (L*). Moreover, observers expected mellow taste of Thai milk tea to have both sweet and bitter tastes.

Keywords: Thai milk tea, food colour, taste association, acceptability colour range, colour preference

STUDY ON THE COLOR SCHEME OF TAIWAN'S NATIONAL CRAFT BRANDS

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ABSTRACT

The National Taiwan Craft Research and Development Institute under the Ministry of Culture of Taiwan started the National Craft Brand Project in 2007 and created the National Craft Brand called Yii. Over fifteen years, many outstanding craft works have been created and exhibited in internationally renowned exhibitions, and have received good reviews. The most distinctive feature is the experimentation of the collaborative design model by inviting product designers and experienced craftsmen to work together, which has provided opportunities for cross-disciplinary professional collaboration and exchange. Between 2007 and 2012, 120 works were created, of which 78 were selected for exhibition and exposure.

This study selects these quality works as case studies to investigate how designers and craftsmen can present the color perception of Taiwan's national craft brands in their collaborative works. It also analyzes the color scheme techniques of these 78 works in an attempt to understand the relationship between the color scheme strategies of the works and Taiwanese craft brands.
From the results of the analysis, it was found that Yii's works can be divided into four color scheme strategies: Traditional oriental artifact colors, original material colors, no color with partial high chroma schemes, and color schemes with cultural connotations, with the original color of the material accounting for the largest number of designs. This color scheme strategy also echoes Yii's core spirit of nature, environmental sustainability and care.

Keywords: National craft brand, Yii, Color scheme

COLOR TRACKING DURING TEA PROCESSING: FROM WITHERING TO SERVING PROCESS

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ABSTRACT

Tea is a legendary beverage that has been consumed for thousands of years. Although it is originally from China, it is becoming a special beverage for several countries in Southeast Asia, including Indonesia. Indonesian tea is planted in large highland areas in Java, Indonesia. Most of the tea plant in the Java area has a specific taste caused by the plantation altitude and the production process. The process of making tea itself is a long journey starting from the plantation until it reaches the consumers. Tea leaves pass through some processes, including withering, rolling, fermentation, and drying. Those processes can be defined as a color journey that figures out a color change of the raw material starting from green until it turns black. The color changes can be tracked and presented in a series of photos. These color changes in each process were identified by using a L*a*b*. This study aims to explain the process of making black tea and discover the color changes using the L*a*b* values in each process. The tea leaves' color variations from each process were captured using a chromameter. Then the L*, a*, and b* values were identified. The L*a*b* values of each process were then compared to track the color change of black tea production. This study indicated that the tea's color change started from the rolling process, followed by a fermentation process. A photo series of tea leaves showed that the color changes from green to black by reason of the physical and chemical processes. Later, it was found that the fermentation process plays the most critical role in the color change process of black tea since the leaves encounter a chemical change.

Keywords: Black tea, Black tea process, Color journey, L*a*b* color

ORAL

SESSION 5

Color Psychology

PERCEPTION OF FACIAL BRIGHTNESS FOR MELANIN AND HEMOGLOBIN CHANGES

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ABSTRACT

It has been shown that the Japanese perceive reddish skin as brighter than yellowish skin at the same lightness. This may be due to our visual process compensating the characteristics of actual skin color distribution that the lightness of reddish skin is lower than yellowish one. Skin color changes mainly according to the amount of melanin and hemoglobin pigment components. Hemoglobin is primarily related to the redness of the skin, and the skin becomes redder and darker if blood flow increase. In this study, we investigated whether facial brightness was perceived in response to changes in skin lightness caused by changes in melanin and hemoglobin pigment components. In the experiment, we used a face image and a uniform image with the average skin color of young Japanese women for stimuli. We prepared test images in which the concentration coefficient was varied in six steps from 0.4 to 1.9 in the melanin and hemoglobin directions and additional 21 steps in the hemoglobin direction. The skin becomes yellowish as melanin concentration increases and becomes reddish as hemoglobin concentration increases. The apparent brightness of each image was measured by a matching task. We prepared images that only change lightness with a constant hue for matching stimuli. A test and matching stimulus was presented on the left and right of the display. Observers matched the brightness of the matching stimulus to the test stimulus. The results for the face image showed that the skin color appeared brighter than its actual lightness when the melanin concentration decreased, suggesting that the face appeared brighter for low saturation skin. In the direction of hemoglobin increase and decrease, the face image appeared brighter than the actual lightness. The results of the uniform images did not show a similar trend as the face images. The face images were perceived as brighter than the uniform image in hemoglobin change direction. This difference was statistically significant when the concentration coefficient exceeded 2.0. Overall, observers tended to perceive the face as brighter than the actual skin as the hemoglobin concentration increased. This suggests that the human visual system can perceive face brightness by compensating for changes in skin lightness caused by the pigment content of the skin.

Keywords: Melanin, Hemoglobin, Facial brightness, Brightness perception

EXPRESSION OF IMPRESSION WORDS WITH COLOR

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ABSTRACT

Previous researchers have examined expressing the senses using color and have identified that fragrance and music expressed by colors have the same impression if the tendencies of the colors used in the expressions are similar. The purpose of this study was to examine the expression of adjectives by color. We created a 25-color pattern with reference to previous research using red, yellow, green, blue, and purple and four combinations of lightness and saturation. We used 20 chromatic colors with 4 hue and lightness / saturation levels and 5 achromatic colors of equal levels from white to black. For the study, we created an Apple iPad app that randomly presented participants with words one by one. We used 50 adjectives for the evaluation, 40 of which were 20 pair words for fragrance and music used in previous studies; we added five pairs of words centered on taste. For each presented word, the study participant used the 25 colors in the app to express the word, with the option to freely change the size of each color. Respondents could also use any number of colors or just one. The evaluation time was measured, and the confidence of the evaluation was evaluated as 0–100. A total of 64 university students (age: 21.42 ± 0.79, normal vision) participated in the experiment. There were high negative correlations between adjectives with opposite meanings, for example, "light–heavy" ($r = -0.890$) and "bright–dark" ($r = -0.917$). In addition, as shown in previous studies, some words reflected the impression in hue and some words reflected in lightness and saturation. The overall mean of the self-confidence evaluation was 73.6, which showed the validity of the expression method by color.

Keywords: Impression, Application, Expression

USING COLOURED PAPER TO INCREASE MEMORY RETENTION: A STUDY ON CHROMA

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ABSTRACT

This study investigated how the chroma of coloured paper affected long-term memory. Fifty observers participated in the experiments. They were university students, ranging in age from 20 to 35 years old. The test samples were divided into three groups: control, warm and cool colour samples. The control samples were papers commonly used in the market for photocopying (plain white paper) and book printing (yellowish paper). The warm and cool colour groups were pink and green, respectively, with four different chroma levels in each group. Hence, there were ten different colour samples in total. Ten stories were originally written for the memory tests. All the stories had similar plots with 2-3 major events and 3-5 main characters. In every story, there were specific names of places and people, and some numbers. Each story had a length of one A4 page (25 lines of 16 point Cordia New, single line spacing), and was randomly printed on the coloured papers. Each observer read one story on a particular coloured paper. They were not allowed to take notes, highlight, or make any marks on the paper. There was no time limit for reading and memorising the story. After 24 hours, the observers returned to answer 15 multiple-choice questions for the memory test. The test contained 10 questions about specific names and numbers in the story and 5 general questions about the storyline. The scores of 10 were taken from the questions on the specific names and numbers. All observers completed the experiments for all 10 coloured papers. The findings revealed that depending on the individual observers, reading on a paper with either a warm or cool colour could improve memory retention. Thirty observers had higher scores for warm colour papers than cool colour papers. On the other hand, twenty observers scored higher when reading on cool colour papers. The effects of chroma were found to be statistically insignificant. However, there was a tendency that a certain chroma level had a higher score than the others.

Keywords: long-term memory, warm colour, cool colour, coloured paper, chroma effect

AN EXPERIMENTAL RESEARCH ON COLOR AFTERIMAGE

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ABSTRACT

Perception is private but still a major topic of scientific investigations. Color experience, as all visual perception experiences, is also personal and subjective, and is impossible to accurately describe the perceived color with simple narratives or random numerical ratios. Color afterimages, the chromatic experiences perceived in the visual field when viewing a blank area after an inducing or adapting stimulus was presented on the area for a certain duration. Research about color afterimages usually focused on the color appearances of the afterimages, and various methods to measure the appearance of afterimages had been developed in different researches. Some researchers tried to find the correlations between color afterimages and other color phenomena, such as simultaneous color contrast, complementary colors, color constancy, chromatic adaptation, color memories, and even the misbinding of color and form. The neural locus of color afterimages was another focus of many studies. The chromatic adaptation mechanism shown by the afterimages could be in the retina, in the brain, or both.

In the present study, the Natural Color System (NCS) is used as the color appearance reference system to measure and represent the color appearance of afterimages. The inducing (adapting) stimuli are selected color patches with various hue, chromaticness, and blackness according to the NCS notations, and the induced (adapted) afterimage colors are determined by the observers also according to the NCS notations. The adapting stimuli are presented on a digital LCD panel or made from NCS color chips attached on cardboard and displayed with standard daylight illumination. In addition to the hues contrast between the inducing stimuli and induced afterimages, the spatial and temporal parameters of the inducing stimulus presentation and the induced afterimages are also measured and compared on the basis of the NCS color space. The data are used to build a model about color afterimage formation efficiency and suggest some guidelines for design applications about using induced afterimages.

Keywords: Color Afterimage, Natural Color System, Visual Psychology, Color Opponent

ORAL

SESSION 6

Color Technology

AUTOMATIC COLORIZATION OF GRAYSCALE LANDSCAPE IMAGES BASED ON CONVOLUTIONAL NEURAL NETWORKS

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ABSTRACT

There are so many colorless photos and films in the world, however, it is too difficult to correctly colorize them by technicians or computer programs. In order to solve this problem, we propose a method, which is based on convolutional neural networks (CNNs) and image classification, to automatically colorize the grayscale image.

The aim of this study is to correctly colorize achromatic landscape images. To this end, we collect and divide a dataset into 7 landscape categories, such as broadleaf, desert, sky, etc. We used the dataset to train our classification network, and the global features extracted by the network can improve the colorization results. Conventional CNNs can effectively extract image features, but it limits receptive fields of the convolution, so we propose a network architecture using dilated convolution and asymmetric kernels with spatial attention modules.

In this research, we evaluate our colorization model by a psychovisual experiment, in order to provide a subjective view of the pros and cons of the proposed model. The subjective scale we evaluated in the experiment including color saturation, color segmentation, and overall performance. The results show that the proposed colorization model is acceptable to most people.

Keywords: Colorization, Convolutional neural network, Image recognition, Psychovisual experiment

RESEARCH OF PSEUDO COLOR RENDERING FOR INFRARED IMAGES

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ABSTRACT

Infrared light is divided into several divisions, including a short-wave infrared spectrum that ranges from 0.9 to 2.5 um, a medium wavelength infrared spectrum that ranges from 3 to 5 um, and a long-wavelength infrared spectrum ranging from 8 to 14 um. Infrared images have broad applications, including surveillance, detection, medical, industrial inspection, and scientific research. Raw infrared images are gray scaled, and grayscale infrared images are hard to have high visual contrast. Thus, this study aims to increase the contrast of the infrared image by transferring grayscale infrared images into pseudo color rendering images. The first step is to collect infrared pictures of different scenes. The second step is to build pseudo color rendering functions based on different loci in CIE 1964 color space or. Lastly, establish a rating method to compare pseudo color images generated according to different color loci. The final goal is to find a color locus that the color-difference Delta E of its color distribution is larger than one. Each gray level in an infrared image could be clearly displayed after it is transferred to a pseudo color image based on the color locus to significantly increase the visual contrast and maximize the readability of infrared images.

Keywords: Pseudo color, Infrared image, Rendering

MACHINE LEARNING TECHNIQUES FOR CLASSIFYING RICE GRAIN

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ABSTRACT

The agricultural industry's is an important part of the economy. However, specifically rice grain has always been one of the main reasons, which directly harms the development of agricultural economy. Machine learning technologies are being used in agriculture such as quality control and classification of grains that are very important for more productive and sustainable production. This proposes the employs machine learning image classification techniques. Using neural networks, the method was developed techniques to accurately classify imagery based on a large dataset of rice grain. The rice grain images were added to the training set and test set, which improved the diagnosis performance with image augmentation methods. The results show that the performance metrics were compared with other machine learning techniques, including DensNet201, VGG16, Inception-ResNetV2, Inception, and ResNet50. The proposed machine learning techniques has achieved higher accuracy and lower processing time, which has a great potential to be adopted by agricultural industries for automatic rice classifications.

Keywords: Machine learning, Machine vision, Classification, Rice, Neural Network

OPTIMIZATION OF THE TEA LEAF FERMENTATION PROCESS RELATED TO THE COLOR OF THE BLACK TEA

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ABSTRACT

Black tea is one of the most popular commodities among Indonesians. Tea drinking culture is something that is prevalent in society. Tea business companies must maintain the quality of their products to meet the demands of the community. Aroma, flavor, and color are the major components in determining the quality of tea. The production process of orthodox black tea includes withering, rolling, fermentation, and drying. One of the most essential standards in generating high-quality goods is the tea production process which is influenced by the fermentation process. It defines black tea color in its infusion and dried leaves. The aim of this research is to establish the optimum fermentation time by examining color changes that occur in the final tea product. The study was carried out by determining the best fermentation time to get the color of the black tea color in its infusion and dried leaves that met industry specifications. The fermentation was performed at various times between 20 to 80 minutes. Samples were collected from each of the different fermentation frames every 5 minutes. Both the color of dried and infused black tea were compared to the tea product sample and the matching sample. The Chromameter Konica Minolta CR 400 was used for measuring L*a*b* of black tea. The sensory quality evaluation with expert panelists was also used to verify the color of infused black tea. The results revealed that the hue of the finished product was different between dried black tea and black tea-infused water with a value of ΔE* L*a*b* was 8.479. The color change in black tea color in its infusion and dried leaves was affected by the fermentation time. The optimal fermentation time was 55 minutes which was compared with the product specification of the industrial buyer. Coppery black dried black tea with light-infused was the most demanding specification of black tea for the domestic and global market.

Keywords: black tea, fermentation process, color, tea quality

ORAL

SESSION 7

Color Education & Color Therapy

DEVELOPMENT AND EVALUATION OF A COLOR SCHEME TRAINING APPLICATION FOR DIGITAL DEVICES IN COLOR EDUCATION

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ABSTRACT

In this study, we developed a color training application for digital device displays, with special attention to the appearance of colors on screen. Moreover, we evaluated the application in use. The purpose was to assist in the learning of color mechanisms and schemes in color education. The main features of the application are the function to customize the color palette and question items used for learning, the function to adjust color-area ratios for the selected color scheme, and the function to save and archive training results as digital data. Since the system is implemented as a web application, it is independent of the digital device's platform (e.g., Windows or Mac OS). Color selection from the color palette is performed with a simple mouse click—a digital capability not possible with conventional materials such as a brush and paint set or colored paper. Furthermore, the application allows for the selective adjustment of color-area ratios, which makes it possible to confirm not only the color selection trends of learners but also other user trends, including the coloring ratios (that is, color schemes) selected. For the evaluation of the color training application, female university students (aged 18–22 years) used the application with 156 color palettes and responded to an online questionnaire. The questionnaire items included the evaluation of the color training application's effectiveness for color education; the time spent by the learner using the application; the confirmation of each user's own color usage trends (user specific characteristics, including habitual preferences); and the number of colors the user considers appropriate for a color training application. Results were as follows. In response to the question item "The color training application helped me to become interested in colors," 84.8% gave a positive response, selecting one of the two top ratings, "I agree" and "I somewhat agree." In response to "The color training applications helped me identify my own color use tendencies (habits and characteristics)," 87.0% of learners selected one of the two top ratings. For "The color training application helped me to better understand the effects and impressions of colors," 93.5% of learners selected one of the two top ratings. These results indicate that the use of the color training application was effective in helping users learn about the mechanisms of color, color schemes, and so on.

Keywords: Machine learning, Machine vision, Classification, Rice, Neural Network

DESIGN OF COLOR EDUCATION PROGRAMS FOR UNDERSTANDING THE DIVERSITY OF COLOR VISION

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ABSTRACT

The concept of diversity in color vision refers to an understanding of the inherent variation in human color vision. However, this notion is not yet widely understood in Japan. It has been reported that students with color vision deficiency often face difficulties communicating with others about distinguishing particular colors, or lose confidence when describing colored objects using the "correct" colors during school activities. The purpose of the current study was to create pilot color education programs for learning about diversity of color vision through experience, and to identify technical and conceptual issues to consider for implementation in school education. We conducted a literature research and identified three important aspects of education regarding color diversity: 1. understanding the existence of variation in the sensation of color through direct experience; 2. understanding that there are some color combinations that people with color vision deficiency have a greater ability to distinguish; 3. understanding that differences in color vision do not imply superiority/inferiority, but that each person's unique color world is valuable. On the basis of these three points, we designed three different workshops. The first workshop was called "the Color Detective." We asked participants to wear colored goggles while attempting to identify the correct color of colored cards in a group activity. The second workshop used an application called "the Hidden Plate Maker," which we developed. We asked participants to identify the objects in photos that displayed hidden plates using our application. The third workshop was a painting workshop called "What color is this pigment!?" We asked participants to wear colored goggles and try to draw on a large canvas with their teammates, and to appreciate others' canvases after painting. Using questionnaires and interviews, participants' feedback was qualitatively analyzed. The results identified several aspects of the workshops that should be updated (e.g., including a more understandable explanation for students, providing a stronger link between participants' experience and the concept of interest, and the modification and adjustment of the workshop to suit a real educational setting). Additionally, we received positive feedback about some aspects of the workshops, including the potential for students to learn about the concept in a fun way, the possibility of providing education to teachers, and the recognition of color vision deficiency as part of diversity. We created three workshops as education programs in this study. The results indicated that our workshops contributed to promoting the idea of understanding that the properties of human color vision exhibit inherent variation, instead of considering people with color vision deficiency to have an anomalous sense of color. For the further development of these programs, we will modify the content on the basis of the feedback obtained in

this study, and test the revised workshops on participants.

Keywords: Diversity of color vision, Color vision deficiency, Color education, Inclusion, Arts

THE EFFECT OF USING IMMERSIVE VIRTUAL REALITY ON COLOR LEARNING

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ABSTRACT

Learning color in the current curriculum is usually lecture-based and students usually have misconceptions and limited retention. Chromatology is essential in the art and design industries. Virtual reality removes the limitation of time and space. It facilitates students to learn and explore more actively in the learning environments. The head-mounted devices provide a more immersive environment for students to enhance their learning motivation. Studies have found appropriate learning environment should be integrated into color education. We tried to propose a virtual reality learning environment in that students could gain practical experiences and explore knowledge on their own. In this study, immersive virtual reality was integrated to improve color learning and the effect on students' learning was further discussed.

Keywords: Virtual reality, Color learning

EFFECT OF THE QUALITY OF NATURAL COLOR AND INGREDIENTS ON ANTHROPOSOPHY ART THERAPY

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ABSTRACT

Anthroposophy Art Therapy was developed from the color theory of Joan Wolfgang Goethe, which focused on the phenomenon of color on the inner human sensation [1]. Anthroposophy Art Therapy emphasizes on the development of human inner beings through art, i.e., through the use of watercolor, pastel color, and crayon in painting and through sculpting. Therapists often use chemically-derived color because they are convenient, easy to find, and bright. This paper describes a qualitative study which the objective was to study the effect of natural color quality on the process of Anthroposophy Art Therapy. We surveyed the production location of the colors and tested them in therapy sessions. In testing, we chose primary colors of red, blue, and yellow, and secondary colors of orange, green, and purple. Components tested were intensity, brightness, and tone of the colors. The participants in the study were 10 therapists, 96 lay-person and 14 patients. The study was organized through 15 workshops(5 workshops for therapists and 10 workshops for lay-person), held for three hours each. Research instruments include field records and assessment form. The data was analyzed by identifying the frequency, mean, standard deviation and analysis of the content. The results revealed that the quality of naturally-derived colors from 2 manufacturers were dull and unsatisfactory. They are also expensive due to complex production processes, deeming them unsuitable for Anthroposophy Art Therapy. However, there was one manufacturer that produced natural colors from local plants and which satisfactory brightness. The processes were simple, such as grinding and boiling, and thus are inexpensive. The plants he used were beetroot (red), butterfly pea (blue), turmeric and Rong thong (yellow). We could use these colors in the therapy although they fade easily over time, since we do not focus on the final work in Anthroposophy Art Therapy, but rather emphasizes on the process of painting and how the recipient "feels" with the colors.

As for the overall satisfaction from using water natural color in the workshop, it was found that the therapists had a high level of satisfaction with the water color with an average of 4.51, followed by a high level of satisfaction for lay-person. The least satisfactory result is from the patient group, but still at a high level of 3.71. As for the satisfaction with the crayon color experiment, it was found that the lay-person had a highest level of satisfaction, with the mean of 4.05, followed by the therapist's satisfaction. The group that is the least satisfied is treatment recipient at the mean 0.57.

Keywords: Anthroposophy, Art therapy, Natural Color

POSTER SESSIONS

Session 1 Color Vision

Session 2 Color in Art & Design

Session 3 Color Management

POSTER

SESSION 1

COLOR VISION

INVESTIGATION OF VISUAL COLOR PERCEPTION IN COSMETICS USING STANDARD LIGHT SOURCES

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ABSTRACT

The study aims to investigate how the light source's correlated color temperature (CCT) affects a user's perceptual attributes, such as preference, naturalness, and vividness when viewing cosmetic color. Four standard light sources, including A, D65, TL84, and CWF, are tested in the study. As a result, the TL84 white light source can provide the best naturalness. The observers prefer light sources with low color temperature, and A white light source is more conducive to enhancing the vividness of cosmetic colors for both lipstick and eyeshadow color. The psychophysical experimental results can provide the best lighting design for makeup applications and be regarded as a reference for international lighting organizations to formulate the related standards.

Keywords: Illumination technology, Light source, Preference, Color quality, Cosmetic color

EFFECTS OF DYNAMIC LIGHT ON SLOW-WAVE SLEEP AND MEMORY

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ABSTRACT

Light is an effective stimulator that regulates body's circadian rhythms, hormones, and behavior. According to our team's previous researches, dynamic light is very effective in improving circadian rhythm disorders, promoting sleep efficiency, and improving work efficiency. This study further explored the effect of dynamic light on sleep and memory by comparing different lighting conditions during a nap. This experiment recruited 14 volunteers with an average age of 23.3 years. Each volunteer underwent three afternoon nap tests with polysomnographic recording, including EEG (Electroencephalography, EEG) and ECG (Electrocardiography, ECG). The first nap test was to allow the volunteers to adapt to the sleeping environment in the lab. The second and third nap tests were to compare the sleep under two lighting environments: a dynamic color temperature and a fixed color temperature lighting. Questionnaires were administered to measure the degree of sleepiness and emotional state of the volunteers before and after each nap. A word-pair memory test was also conducted to assess the memory consolidation during the nap under two different light sources.

The study hypothesized that dynamic color temperature can increase sleep slow wave activity (SWA), parasympathetic nerve system (vagal tone), and promote memory consolidation, emotion regulation during afternoon sleep, as well as to reduce fatigue. The experimental results show that dynamic color temperature lighting is better than fixed color temperature in increasing total sleep time. It was shown that in the dynamic light had significantly increased slow wave activity in C3, C4 and F4 (frontal lobe and parietal lobe area) . However, there is no significant difference in rating of sleepiness, and performance on word-pair memory test and psychomotor vigilance task.

Keywords: Dynamic light1, Slow wave activity (SWA)2, Memory consolidation3, Emotion regulation4, High frequency-heart rate variability (HF-HRV)5.

INITIAL STUDY OF THE EFFECTS OF CHROMATIC LIGHT WITH CONTROLLED SPECTRAL DISTRIBUTION ON CREATIVITY AND ALERTNESS

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ABSTRACT

In recent years, LED lighting has become popular as illumination light, and various light colors have become available by controlling the light amounts of red, green, and blue, which are the three primary colors of light. It is also believed that chromatic illumination has physical and psychological effects on humans. For example, red lights have an awakening effect. Some studies have shown that long-wavelength light increases attention. Other studies have reported that chromatic lighting affects cognitive performance. However, the impact of chromatic lighting on creativity remains unclear. The purpose of this study is to investigate the effects of different spectral distributions and the same dominant wavelength on creativity and alertness. The light colors used in this study were white (W), red (R), green (G), and blue (B), and for R, G, and B, two kinds of light colors with different spectral distributions were prepared so that the dominant wavelengths were as close as possible, for a total of seven different light source conditions. In this study, we conducted a creativity test (a task to create new applications) referring to the TTCT creativity test. The evaluation method was evaluated from four viewpoints of fluency, flexibility, originality and concreteness, and each was evaluated quantitatively and qualitatively. In addition, by measuring the brain waves of the subjects during the experiment, they compared the changes in the brain waves before and after the experiment. As a result, the quantitative evaluation of the creativity test showed that the evaluation of green light was low in flexibility and concreteness, but the qualitative evaluation showed high evaluation. As for the difference in spectral distribution, it was shown that, except for some conditions, the light color with more short-wavelength components among the similar colors had a higher evaluation. On the other hand, it was shown that the alertness increased in the light color with more long-wavelength component.

Keywords: Chromatic light, Spectral distribution, Creativity, Alertness, Dominant wavelength

ESTABLISH 3-D PERCEIVED WARMTH MAP OF THE MUNSELL COLOR SYSTEM

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ABSTRACT

The purpose of this study is to establish a perceived warmth map of the Munsell colors in terms of the combinations of hue, lightness and chroma attributions. The digital Munsell color charts are displayed on an Adobe RGB monitor as the test samples. Besides, the colors of '5G' hue with varied lightness are regarded as the reference colors to evaluate the cool/warm degrees of the other chromatic samples with the equal lightness. The categorical judgment method is utilized to produce the score data. Finally, a perceived cool/warm contour map of Munsell color system were established.

Keywords: cool/warm map; warm and cold colors

THE EFFECTS OF WEARING SPECIAL GLASSES THAT ATTENUATE LIGHT WITH WAVELENGTHS AROUND 585 NM ON COLOR PERCEPTION

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ABSTRACT

We investigated the effects of wearing special glasses (NeoContrast, Mitsui Chemicals) that attenuate light with wavelengths around 585 nm on color perception. Previous studies reported that these glasses increased contrast sensitivity [1] and made red and green colors appear more vivid [2]. However, the effects on other colors have not been examined yet. Therefore, we examined the effects of wearing these glasses on the color perception of a wide range of hues using the Munsell color chart. Experiment 1 examined the effect of wearing these glasses on chromatic colors. Ten adults (6 females, 4 males; ages 21–30 years, mean age = 24.7 years) participated, and no one reported to have color vision deficiency. They observed Munsell color charts with and without these glasses. As a result, these glasses made all colors appear more vivid. Experiment 2 examined the effect of wearing these glasses on achromatic colors. Four adults (3 females, 1 male; ages 23–26 years, mean age = 24.5 years) participated, and they also participated in Experiment 1. They observed color charts with and without these glasses as in Experiment 1. As a result, there was no appearance of color on achromatic charts. Experiment 3 investigated the effects of visual adaptation after wearing these glasses. Ten adults (6 females, 4 males; ages 21–27 years, mean age = 24.0 years) participated. No one reported to have color vision deficiency, and they did not participate in Experiment 1 and 2. They rated vividness, beauty, preference and attractiveness of color charts immediately after wearing these glasses, 5, 10, 15, or 30 minutes later. The results showed that the ratings did not change significantly up to 30 minutes after wearing these glasses. In conclusion, these glasses made a variety of colors more vivid and there was no adaptive change in this effect.

Keywords: Color perception, Special glasses, Light with wavelengths around 585 nm, Vividness

Color Matching Experiment for Moving Point Light Source

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ABSTRACT

Small-field tritanopia has largely been studied in terms of object color using color patches and light source color using narrow-band illuminants; however, wide-band light source colors, such as LEDs, have not been similarly investigated. In our previous study, the authors analyzed the color perception of LED point light sources with a wide-band spectral distribution by conducting color matching experiments in scotopic vision. Those previous studies were conducted on stationary stimuli and did not clarify the effect of motion on color perception of small-field stimuli. Regarding the color perception of small-field stimuli in motion targeted in this study, a color matching experiment of color perception of a moving LED point light source is carried out. The results differed from the color appearance of static stimuli in previous studies, and they suggest that color perception depends on the speed of movement.

Keywords: color perception, small-field stimulus, moving stimulus, LED, viewing angle

THE CONGRUENCY OF COLOR-SOUND CROSSMODAL CORRESPONDENCE ENHANCES/INTERFERES WITH COLOR AND SOUND DISCRIMINATION DEPENDING ON THE COLOR CATEGORY

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ABSTRACT

People associate a specific color characteristic with a specific sound characteristic, as in the Japanese expression "Kiiroi seien" (yellow cheer), which describes the color as a sound. Previous studies have reported that people associate yellow with high pitches and blue with low pitches. Such particular color-sound associations are called crossmodal correspondence. It is unclear how the color-sound crossmodal correspondence affects the integration of the audiovisual information which interacts with each other. To clarify the aspect of the crossmodal interaction in the audiovisual integration process, this study aimed to investigate how the congruency of color-sound correspondence enhanced/interfered with discrimination. Three experiments were conducted, in which the Stroop tasks were performed to assess the enhancement and the interference. We focused on the crossmodal correspondence between sounds (things falling/bell ringing) and colors (yellow/blue) (Exp. 1) / words representing colors (yellow/blue) (Exp. 2). Participants were asked to judge either the color/word or the sound simultaneously presented. Those results showed the bidirectional enhancement/interference by the congruency of the crossmodal correspondence in both Exp. 1 and 2, though two experiments differed in whether the color patches or the color words were used as the visual stimuli. These results suggest that the crossmodal Stroop effect is caused by the semantical factor (color categories), not by the perceptual factor (color appearance). Next, we hypothesized that the Stroop effect would occur for any colors within a color category, not just typical colors. In Exp. 3, participants were asked to judge the color category of a presented color patch while listening to a sound. The responses were divided into two groups, the within- and outside the category boundary, based on the color category threshold of each participant. The ANOVA results revealed a significant interaction between crossmodal congruency and category. This indicates that the Stroop effect occurred only within the category boundary, but not outside the category boundary. These results indicate that crossmodal correspondence is used in color discrimination and may occur depending on whether the within or outside the color category boundary.

Keywords: Crossmodal correspondences, Audiovisual integration, Stroop effect

RELATIONSHIP BETWEEN BRIGHTNESS PERCEPTION AND PHOTORECEPTOR STIMULATIONS INCLUDING MELANOPSIN

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ABSTRACT

Melanopsin cells, a type of photoreceptor in the retina, were discovered around 2000. In the literature, they contribute to the regulation of circadian rhythms and pupil's response to light. They receive inputs from three types of cones and rods and contribute to the non-imaging forming pathway such as pupil response and photoentrainment of circadian rhythm. In addition, the melanopsin cells contribute to brightness perception.

Brightness sensitivity is expressed as specific visual sensitivity. Luminance is defined by CIE (Commission international de l'éclairage) to provide the amount of brightness. Luminance is derived from minimum flicker method, which uses high-temporal frequency stimuli. Several studies have shown that L and M cones, but not S cones, can contribute in minimum flicker. On the other hand, another brightness sensitivity, particularly to static stimuli, has also been proposed. This luminous efficiency function is derived from direct heterochromatic brightness matching.

The visual sensitivity derived by direct heterochromatic brightness matching has a wide bandwidth in wavelength compared to that derived by minimum flicker. The direct heterochromatic brightness matching uses static stimuli, which has a low-frequency component, suggesting that S cones and melanopsin cells could contribute. It is, therefore, important to investigate how melanopsin cells and cones contribute to the brightness sensitivity derived by direct heterochromatic brightness matching. The purpose of this study was to investigate the contribution of melanopsin cells in brightness sensitivity derived by direct heterochromatic brightness matching.

In the experiment, a multi-primary illumination system was used, which allows the independent stimulation of each photoreceptor. Before the session, observers had the initial adaptation for 5 minutes. We used two-intervals alternative forced choice procedure (2IAFC) to measure brightness perception. The test and reference stimuli were presented for 1 second. The reference and test stimuli were switched gradually to avoid artefacts due to rapid changes in the stimuli. The order of the test and reference stimuli was counterbalanced. All stimuli had equal luminance in minimum flicker, but different brightness based on direct heterochromatic brightness matching.

The results showed that test stimuli of the same luminance caused different brightness perceptions. Brightness perception increased as luminance derived by direct heterochromatic brightness matching increased. In addition, brightness perception increased as melanopsin stimulation in the stimuli increased. These results suggest that melanopsin cells as well as cones contribute to brightness perception based on direct heterochromatic brightness matching.

Keywords: brightness perception, melanopsin, heterochromatic brightness matching, photoreceptor stimulation

A STUDY ON COLOR SORTING BY USING THE FARNSWORTH MUNSELL 100 HUE TEST

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ABSTRACT

The primary purposes of this study are: (1) to compare two different color temperatures of lighting when assessing the color sorting task by using the "Farnsworth Munsell 100 Hue Test"; (2) to analyze the different majors of the observers who has a color training background or does not. Twenty observers (10 females and 10 males) were invited to join the color sorting assessment. Seven observers from the College of Arts & Design and thirteen observers from other majors. Each observer should finish two trials (daylight and home light) based on the Quasi-experimental method. Each observer took approximately 2-3 minutes to complete one of four boxes. At the end of each task, the score and the assessment duration had recorded using the 100 Hue Test analysis software. An independent t-test analysis method has been used to analyze the variance in sex, major, and lighting. When the observers were doing the task, have noticed that most of the observers took more time in the Home light environment than in the daylight environment, they faced more difficulties in the Home light environment to sorting the task because Daylight produces a higher color temperature in the range of 6500 K, whereas the Home light produces a lower color temperature in the range of 4300k. The results of the T-test show: it's no significant difference in the major on the duration (p=.585) and score (p=.063) variance. There is a significant difference (p=.012) between sex on the duration variance. It's no significant difference (p=.555) between sex on the score variance. Even if the male spent more time assessing the color sorting, the assessment score is almost the same results as the female. Thus, it doesn't matter whether the observer is male or female or has a color training background or does not. It depends on the observers' color sensation and perception.

Keywords: Munsell 100 hue test, color sorting, Quasi-experimental, independent T-test

THE RELATIONSHIP BETWEEN THE STEADY-STATE PUPIL RESPONSE AND BRIGHTNESS SENSITIVITY OBTAINED BY DIRECT HETEROCHROMATIC BRIGHTNESS MATCHING BASED ON MELANOPSIN STIMULATION

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ABSTRACT

In this study, we investigated the relationship between the steady-state pupil response and brightness sensitivity obtained by direct heterochromatic brightness matching. A recently discovered photoreceptor, ipRGC (intrinsically photosensitive retinal ganglion cell, or melanopsin cell) contributes to non-image forming pathway such as photoentrainment of circadian rhythms and pupillary light reflex. Although a large number of studies have been made on the investigation of non-image forming pathway in rodents, little is known about humans. It is important what kind of attributes of ambient light (i.e. color luminance and melanopsin stimulation) most influences the non- image forming pathway in humans. In this study, therefore, we measured sustained pupil responses to steady light with various kinds of photoreceptor stimulations including melanopsin cell.

According to the literature, melanopsin cells contribute to steady-state pupil response and brightness perception. The brightness sensitivity is known as luminous efficiency function, V(λ), which is obtained by minimum flicker and the luminance of light is calculated from it. Since minimum flicker uses high-frequency stimuli melanopsin cells cannot respond to it. There is another brightness sensitivity, Vd(λ), for static stimulus, which obtained by so-called direct heterochromatic brightness matching and a luminance with Vd(λ) can also be calculated. The spectral sensitivity of Vd(λ) is broader on the long- and short-wavelength region compared to V(λ). The broad shape of Vd(λ) suggests that S-cones and melanopsin cells contribute to brightness sensitivity as well as L- and M-cones.

In this study, we investigated the relationship between the steady-state pupil response and brightness sensitivity obtained by direct heterochromatic brightness matching. The experiment used a multi-primary stimulation system that can independently stimulate each photoreceptor at retina. We used three stimuli according to stimulation of Vd(λ), which were LdMax, LdMiddle and LdMin stimuli, respectively. These stimuli had the same luminance, whereas had the different luminance by direct heterochromatic brightness matching. In addition, these stimuli had different melanopsin stimulations. The observer's right eye was exposed to full-field stimulation and the steady-state pupil response of the left eye was measured. The measurement was started after an initial adaption for 5 minutes.

The results showed that a large difference in steady-state pupil response between LdMax and LdMin stimulus. The pupil response to LdMax stimulus was greater than that to LdMin stimulus. These results suggest that steady-state pupil response correlate with brightness sensitivity obtained by direct heterochromatic brightness matching.

Keywords: Pupillary light reflex, Brightness, Luminance, Melanopsin, Non-image forming pathway, Direct heterochromatic brightness matching

PERCEPTUAL ALTERNATION IN COLORED SWITCHING GLARE ILLUSION

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ABSTRACT

In a glare illusion, illusory brightness enhancement with self-luminous perception is observed to a pattern where a central white area is surrounded by radial darkening luminance gradients (Zavagno, 1999). Previous studies revealed that although self-luminous perception did not arise in lowluminance states of the glare stimulus, the brightness enhancement still arose (Tamura, et. al., 2016), and there were some differences in the intensity of illusory effect among different color conditions (Suzuki, et. al., 2019). Therefore, the glare illusion is considered to be a complex but robust phenomenon against a variety of stimulus conditions. Recently, we found that a grid arrangement of cross-shaped glare patterns caused perceptual figure-ground alternations associated with appearance and disappearance of glare perceptions. In this phenomenon, the strong glare perception appears when the grid of cross-shaped glare patterns is perceived as a figure. On the other hand, the glare perception disappears and amodal completion arises behind the gap when the grid pattern is perceived as a ground. We named this new illusory perception the switching glare illusion and began to study about it to reveal the mechanisms underlying the phenomenon. In this paper, we examined whether or not there were any effect of colors on the switching glare illusion. We investigated the frequency of perceptual alternation and the stability of each perception by measuring the timing of the perceptual alternation and the duration of each perception reported by observers. We tested nine patterns of the colored switching glare illusion as stimuli. There were five conditions of colors on luminance gradients (white to black, white to blue, white to red, blue to black, red to black) and four conditions where two types of the colored luminance gradient patterns were combined in different arrangement. As a result, according to the observer's response and reported appearance, all of stimulus conditions caused perceptual alternation, and there were some differences in the states of appearance among the color conditions.

Keywords: glare effect, brightness perception, visual illusion, figure-ground, amodal completion

POSTER

SESSION 2

COLOR APPLICATION

LIBERATION OF COLOR: THE COLOR THEORY OF KANDINSKY

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ABSTRACT

Color Theory is the source of inspiration for western artists from the 19th century. Color Theory pushes their creative work towards abstraction. Artists from the late 19th century were influenced by French Neo-Impressionism's Divisionism Theory. Therefore, when artists explored color, they were not restricted by the requirements of the object itself. They pursued the power of color, implying that the activity when color is separated from its figurative function. While color theory became a key source for many pursuing color liberations, Kandinsky explored inner artistry. His book "On the Spiritual in Art" published in 1912, emphasized that color is not based on any explicit scientific basis. Instead, it is the result of experience and feeling, and color is a means of exerting a direct influence on the soul. In his writings, he announced that he would smash the burden of materialism to seek the liberation of art and advocated that the purpose of art is not to capture the specific shape of things but to capture its essence and soul. Kandinsky's beliefs are influenced by metaphysics rather than science, and in his writings, he alludes to the use of color to achieve complete abstract creations. This study begins with "On the Spiritual in Art" and explores the color theory that underpins Kandinsky's development toward abstraction. Kandinsky pursued the mystery and spirituality of colors from the color theory of the theosophical scholar Steiner, and religious belief was one of the keys to his completion of the color theory. Kandinsky creates harmony with the opposition and contradiction produced by the color contrast. He believes that harmony is based on the principle of opposition and is the main principle for creating art in any era. The theory of color contrast comes from the influence of Adolf Hölzel. The sensory and spatial contrast produced by color contrast can make the color spiritual. By overcoming the materiality of painting and creating "immaterial painting", which is achieving abstract arts' "principle of internal necessity".

Keywords: Theosophy, Color contrast, Internal necessity

EXPLORING THE COLOR HARMONY OF DIGITAL PHOTOGRAPHY WORKS BASED ON COLOR LANGUAGE THEORY: A CASE STUDY OF FINALISTS' WORKS IN THE 2022 TAIWAN PHOTO CONTEST

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ABSTRACT

In recent years, with the advancement of digital technology, digital photography has quickly become a part of our daily lives. It expresses people's thoughts and feelings through features such as virtual, intuition, and picture as an essential manifestation of modern visual communication. Its one-of-a-kind function of picture transmission has also evolved into a borderless language. Color, on the other hand, is an important aspect in the way digital photography works, since it influences the style and situation expression of creative works. The previous study of the author clearly had shown the priority of the composition of the color images in digital photography. Therefore, the major goal of this study is to investigate the importance and harmony of the color language of finalists' work in the 2022 Taiwan photo contest in digital photography by using a literature qualitative analysis, based on color language theory. After examining the finalists' works, it was discovered that some crucial color harmony was required, such as contrast colors, neighboring colors, and serial colors, as well as gray in digital photography. Finally, it was proposed that, in addition to paying attention to image arrangement, the photographer pay attention to the color concordance of the works, which would improve the quality of the photographs.

Keywords: Digital photography, Color language, Color image, Color harmony

THE CASE STUDY OF BACKGROUND COLORS FOR ORGANIC RICE PRODUCTION MEDIA

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ABSTRACT

This study aims to investigate the effect of interface background colors for organic rice production media. The study group consisted of 50 Thai students at Digital media department of Rajamangala University of Technology Thanyaburi. The background colors were selected from color wheel in Adobe Illust rator to design the media: red, blue, yellow, green, orange, purple, amber, vermilion, magenta, violet, teal and chartreuse. Three expertise of media production were assessed the content, design, and user interface before asking the study group to assess the media. The media consisted of 9 parts to complete the organic rice production (from planting to harvesting) totally 13 minutes length. The media asses sment was used an emoticon (😊= satisfied, 😐= neutral, ☹ = dissatisfied) to show the preference of media. The result suggested the cool tone color was showed the most satisfied such as green, bluish green, greenish yellow etc. The participant opinion was to suggest for background colors used in rice production media that it should be desaturated to have comfortable while they are watching the media.

Keywords: Background colors, Organic rice production media, Emoticon

THE EFFECTS OF FONT-COLOR COMBINATION ON CONSUMER PERCEPTION OF PRODUCTS PACKAGING

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ABSTRACT

Packaging has been compared to a silent salesman. Utilizing packaging design to influence consumer perception and behavior has been one of the essential topics in marketing research. Applying appropriate visual elements in packaging design is not just for better identification of brands but also for communicating product characteristics. To investigate the influence of visual-elements-induced perceptual fluency and thus affects consumers' evaluation of the product, this study examines two common factors in packaging design: color and font. Based on related studies and standard practices of packaging design, we designed four conditions of packaging appearance varied in two levels in color and font: pink and blue, Serif and San-serif fonts. Four color-font combinations were designed to be four versions of the packaging design and printed with a UV printer, photographed in a studio, and then post-produced as commercial ads for a fictional skincare product. In the experiment, 120 participants divided into two groups were separately introduced to two different purchasing scenarios and shown the four commercial ads. The two scenarios described the purchase motivation and product features distinctively, one in a function-orientated way and another in a sensory-social- orientated way. A questionnaire on a 5-point Likert scale was used to assess participants' judgments on the perceptual fluency(congruency) between color-font design and product property, as well as their intents of trying, buying, and recommending the product. The T-test analysis result has shown that the combination of blue-San serif has resulted in significantly higher ratings in the metrics of perceptual fluency and product evaluation in the function-oriented shopping scenario. The pink-Serif combination received relatively higher ratings in the social-sensory-orientated shopping scenario. Linear regression analysis indicated a very evident correlation between metrics of perceptual fluency and product evaluation. Generally, we verified that the specific color-font design affects perceptual fluency. The higher the perceptual fluency delivered by the packaging design, the better the consumer evaluation of the product.

Keywords: packaging, color-font combination, perceptual fluency, consumer evaluation

CREATING INTERACTIVE MEDIA TO TRAIN SHORT-TERM MEMORY SKILLS IN CHILDREN WITH DOWN SYNDROME

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ABSTRACT

Research on creating interactive materials to practice the short-term memory skills of Down syndrome children Aim to 1) To assess the development in memory of down syndrome children after using interaction materials to practice skills in short-term memory. 2) To study parental satisfaction with interaction media to practice skills in the short-term memory of Down syndrome children. The target group is: Down syndrome children in the Center for Intellectual Development the Retarded People's Aid Foundation of Thailand, which has 20 parents and hypothesizes that down syndrome children will develop better in short-term memory after using the media. In a 15-day period.

The research process begins by studying the relevant information and theories, such as: Developmental skills of Down syndrome children in each group Study the content and format of media and tools for practicing the short-term memory skills of Down syndrome children currently available. Problems and uses that occur. Then create interactive media using vivid colors and use game styles that can draw attention to re-learning, practice memory skills, designed by opting for simple colors and procedures, with the learning section and game section to measure 3-game scores, scoring 15 points each, for a total of 45 points. The media is then used to assess the quality from three areas of experts with assessment topics in the field of interaction media. Design and content for promoting the development of Down syndrome children, then improving according to feedback, then applying media to the target audience and collecting information. In the process, the researchers delivered and demonstrated how media usage was developed to parents of targeted Down syndrome children. To collect the level of scores that the target audience can achieve and how long they can play each day. After that, the satisfaction assessment was conducted by the parents and then processed the scores in different sections to find the average and standard deviation.

Results from the study showed that creating interaction materials to practice the short-term memory skills of Down syndrome children. Developed performance satisfaction assessment results from experts, the three areas are the interaction media with a total average of 3.70 ($\bar{x}$ = 3.70, S.D. = 0.48). The design aspect has a total average of 4.18 ($\bar{x}$ = 4.11, S.D. = 0.60), and the development-promoting content side has a total average of 4.18 ($\bar{x}$ = 4.18, S.D. = 0.40). The overall estimate is 4.00 ($\bar{x}$ = 4.00, S.D. = 0.10). In terms of parental satisfaction assessment of down syndrome children' groups, the total mean is 4.28 ($\bar{x}$ = 4.28, S.D. = 0.06). The joint assessment is good. In the gaming score measurements from the sample, it was found that on the first day, the Down syndrome children took an average of

17.1 points, lasted about 30-40 minutes, and after 15 days, the test averaged 41.95 points, taking the duration down to about 15- 20 minutes, as the samples became more fluent and recognized more content in the media, which was consistent with the objectives and met the set assumptions.

Keywords: interactive media, short-term memory, children with down syndrome

THE EFFECT OF BACKGROUND COLOR ON SUSHI ADVERTISEMENT ATTITUDES ON FACEBOOK

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ABSTRACT

In the previous study, we examined the preferred color of background on pizza, burger, and bubble milk tea on Facebook fanpage and found red background color most preferred for pizza and burger and blue for bubble milk tea [1]. However, the methodology was not well controlled and color specifications were not precise. In the present study, Sushi (寿司) was examined as the food product because Sushi is very popular among teenagers in Thailand. The close-up Sushi image was presented on a display". Eleven background colors were adopted from CIEL*a*b* color space: black, grey, white, 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315°. Their chroma (C*ab) and lightness (L*) were made equal. The Sushi image on the display was presented to observers in pseudo-random order one by one to cover all the eight background colors. The experiment was done in classroom of which illuminance was 500 lx. One hundred observers of students at Rajamangala University of Technology Thanyaburi participated in the experiment. The semantic differential scale was used to evaluate the effects of background colors. The assessment was prepared on google form. Adjectives used for observer scaling were contrast, attractiveness, tastiness, freshness, cleanness, and gorgeousness. The result showed that background color plays an important role for food product advertisement, particularly affected to tastiness and freshness of Sushi.

Keywords: background color, advertisement, facebook, attitude

COLOR EVALUATION IN BOTANICAL PRINTING ON WOOL FABRIC USING TEAK LEAVES WITH AND WITHOUT MORDANTS

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ABSTRACT

This study analyzes the color effect in botanical printing with and without mordants on washed wool fabrics using teak leaves. Wool fabrics were serially digitized, and images were captured using a digital camera with a color management process through a color calibrator and color checker. The reference images were converted from RGB to CIEL*C*h color space, analyzing the interaction effect of variables. The independent variables included four different mordant treatments, i.e., a mordant containing aluminum potassium sulfate, another containing ferrous sulfate, a combo of the two mordants, and without a mordant. The dependent variables included the visual assessment of pattern clarity, color feeling, and the objective consequences of color analysis using L* and C* values. The control variables included the mordanting technique, wool fabric, the upper and lower side of the leaf, and the size and maturity of the teak leaf. The results show that the different types of mordant treatments differentially affected the color appearance and the intensity of the obtained pigments. The upper or lower side of a leaf and the size and maturity of a leaf also affected color appearance in botanical printing. The C* values for botanical printing using the ferrous sulfate mordant were higher than those for botanical printing using other mordants. Specifically, the average C* value for botanical printing without the mordant was close to that obtained using the mordant containing only aluminum potassium sulfate. The appropriate brightness and saturation of color patterns are preferred in botanical printing, and the results of this study provide an application and reference of color appearance in botanical printing practice on wool fabric.

Keywords: Eco printing, mordanting technique, botanical printing, CIELab, CIELCh

A COMPARISON BETWEEN THE PERCEPTION OF THE VIRTUAL TOUR MEDIA ON THE INTERNET NETWORK AND THE REAL SITE VISIT IN ACADEMIC PLACE

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ABSTRACT

The study aims to compare the perception of the virtual tour media, the technology features the display of images or real environments in a 360-degree view that enables surround panoramic view as well as editing images more attractive, on the internet to promote the public relations of the Faculty of Mass Communication Technology, Rajamangala University of Technology Thanyaburi, to whom interested in further study in the faculty or to general visitors. The media includes both interior views of the building such as classrooms, laboratories and computer rooms, and exterior views of the building such as building entrance, recreation area and car park, through replicating all places of the site as same as real visit without the arrival at the real site, in form of a virtual tour, in order to reduce travel consumption and to create social distancing practice as well as providing an option of visiting the Faculty of Mass Communication Technology, Rajamangala University of Technology Thanyaburi. The study compares the perception of a visit from 40 students, who are in Matthayom 6 level and consider to further their study for bachelor degree, of the Thanyarat School, Pathumthani province through the distribution of questionnaires. In this study, a sample of 20 participants visited the real site where is designated for visiting, whereas another sample of 20 participants visited the site through the virtual reality media on the internet network of the school. After the visit, participants were asked to complete the questionnaire. The data analysis applied on the study are the descriptive statistics; the arithmetic mean and the standard deviation, and an inferential statistic; the independent t-test. The result is expected the perceptions of online visitors would be shown at the same level as the perceptions of on-site visitors or the difference ratio of perceptions of two groups does not exceed 20 per cent. It is suggested when an online visit is not different from an on-site visit, a virtual tour of the Faculty of Mass Communication Technology, Rajamangala University of Technology Thanyaburi is applicable for an effective visit. From the previous test, the samples visited on the internet network were furthered additional test through viewing six virtual images taken from the GoPro Max Action Camera 360 and adjusted the exposure, vibrance and saturation settings for six levels in order from the lowest to the highest rate in order to examine the most attractive exposure, vibrance and saturation settings of virtual image. It exhibits the settings of exposure and saturation in the middle level, picture 3, received the most attractive.

Keywords: background color, advertisement, facebook, attitude

THAI FLOWER AROMA AND BASIC COLOR NAME

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ABSTRACT

Thai flower such as Plumeria, Cananga, and Sweet Osmanthus has their unique smell. By extracting the essential oil from the flowers, aroma oil or perfume can be produced from these flowers. These aromas are generally used for oil massage, aromatherapy, and spa. To enhance the recognition of these aromas, the color of the packaging is an important element in the packaging design. Therefore, we investigated the relationship between the aroma of Thai flowers and Thai basic color names. Eight Thai aromas produced from Rose, Jasmine, Plumeria, Cananga, Sweet Osmanthus, White Champaka, Indian Cork, and Moke were used in this research. The sample of each Thai flower aroma was prepared by dropping two droplets of Thai aroma on a perfume test paper. Each Thai flower aroma sample was separately kept in a sealed glass bottle to avoid the fading of smell. The subjects were 109 people aged between 15-60 years old. All subjects had passed the Ishihara test to confirm their normal color vision. The subject's task was to smell a Thai aroma sample and identify Thai basic color names which related to that smell. To avoid the subject's bias, the information about the aroma sample was not provided to the subject during the experiment. For each smell, three color names must be selected from a set of Thai basic color names which consisted of red, orange, yellow, green, purple, pink, brown, blue, sky blue (Fah), gray, black, and white. These color names were presented in Thai language written on a card without showing any color chips. The subject must smell the coffee beans for five seconds and rest for at least five seconds to neutralize their nose before each sample smell. Each subject must smell all eight Thai flower aromas to complete the experiment. Our result exhibited that most Thai flower aromas are generally related to yellow and green. For well-known Thai flowers such as Jasmine and Champaka, the color of aroma is strongly related to the color of the flower.

Keywords: Thai flower, basic color, aroma, fragrance, memory color

A PILOT STUDY ON THE RELATIONSHIP BETWEEN AVATAR APPEARANCE AND PERSONALITY TRAITS

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ABSTRACT

Metaverse originated from the science fiction novel "Snow Crash" published in 1992. The authors use it to describe a virtual social environment. The term “Metaverse” became widely known because Facebook announced in 2021 changing its name to Meta Platforms as it shifts its focus to building a metaverse. In the metaverse, an avatar is an icon or graphic representing a specific computer user in the metaverse of social media, video games, the internet, etc. And it’s becoming increasingly more common to use online avatars to recognize users’ appearance and identification in the metaverse. This raises some interesting questions, such as, who wants to create avatars, how they choose features to represent their appearance, and could personality traits influence the creation of avatars?
In order to investigate the relationship between avatar appearance and personality traits. This study conducted an online questionnaire using Google Forms to ask participants to upload an image of their avatar images. The questionnaire also included the survey of the Big Five Inventory (BFI) identifying personality traits, including extraversion, agreeableness, conscientiousness, neuroticism, and openness. Thirty-seven participants (7 males and 30 females, the average age is 23.9) took part in this online survey. The avatars obtained were classified into two features, including head and top clothes. The head feature involves hair color, skin color, and eye colors. The colors appearing on avatars were identified by using Natural Color System (NCS) by researchers’ visual identification. The frequency of colors appearing on the avatar was calculated based on 8 hue categories and 3 segments in a WSC triangle together with achromatic colors.

The initial results showed that (1) personality traits appeared to have an insignificant effect on the color setting of Avatar's head features, (2) warm colors were used more on Avatar head features rather than cool colors, (3) the orange color is the most commonly used hue on Avatars’ hair, skin, and eye, (4) the participants with the personality traits of Extraversion and Neuroticism tend to use achromatic colors for the top clothes on their avatar, and (5) participants with personality traits of Agreeableness and Conscientiousness chose the color for the top clothes on self-Avatar are diverse.

Keywords: Personality trait, Avatar color

POSTER

SESSION 3

COLOR TECHNOLOGY

COLOR MATERIALS USED IN TOYOHARA KUNICHIKA'S JAPANESE WOODBLOCK PRINT PAINTING (UKIYO-E) AND ITS DETERIORATION

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ABSTRACT

In order to inherit valuable cultural properties to the future, it is necessary to control deterioration and to use various techniques for their conservation and restoration. Simulation modeling of deterioration makes it possible to predict the state of deterioration of cultural properties, which is useful information when considering the conservation or restoration of cultural properties. For more accurate prediction of deterioration, information obtained by material analysis and deterioration tests is required. Therefore, in this study, material analysis of Ukiyo-e was conducted to obtain color material information. Furthermore, we report the degradation simulation based on the data obtained from the forced degradation of color patches and Ukiyo-e based on the color material information. We measured and analyzed the Ukiyo-e "Mitate hashi zukushi Nihonbashi," Parody of Collection of Bridges / Nihon-bashi Bridge (private collection) produced by Toyohara Kunichika (1835-1900), an Ukiyo-e artist active from the late Edo period to the Meiji period in Japan. The color materials used in the red, purple, blue, and gray areas of the Ukiyo-e were measured by X-ray fluorescence analysis and 2D spectroradiometer, and the results indicated that dyes may have been used. During the period when the Ukiyo-e shown here were produced, synthetic dyes and pigments were developed in Europe and used for coloring Ukiyo-e in Japan. The results of the analysis and reports from prior studies suggest that cochineal, methyl violet, Prussian blue, and carbon black may have been used in the red, purple, blue, and gray areas, respectively. Each color patch in the Ukiyo-e was produced using the color materials clarified by the analysis. The color patches were subjected to degradation tests using a sunlight irradiation device, assuming a situation where the patches were exposed to direct sunlight. The Ukiyo-e was also tested for degradation. The color patches and Ukiyo-e were exposed to 168 hours of irradiation using the device, and color information was obtained using a 2D spectroradiometer for 0, 8, 16, 24, 48, 72, 96, 120, 144, and 168 hours to clarify the color changes over time due to UV light. Using the information from the 10-step color patch, a degradation simulation was performed and compared with the degraded image of Ukiyo-e. The degradation simulation using color patches generally showed a fading trend like that of the Ukiyo-e while the shading of the color material and the color change of the base material, Washi (Japanese paper), was needed to be taken into consideration.

Keywords: Ukiyo-e, deterioration, X-ray fluorescence analysis, 2D spectroradiometer, simulation.

COLOR CHARACTERISTICS OF THE HIGH-DYNAMIC RANGE MICRO-IMAGING SYSTEM

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ABSTRACT

New technology has driven displays to incorporate richer color volumes, higher luminance, greater contrast, and more pixels, thereby enabling a wide range of new visual experiences and rising an emerging demand of fast and high-dynamic-range (HDR) color image metrology. This is a growing trend, as the applications for the color measurement systems continue to performance become even greater and faster. In this paper, the color characterization of the HDR color micro-imaging system will be addressed. First, we perform a series of experiments to calibrate the luminance and the color volume of a remote and compact RGBW LED Light as the reference light source. Second, we calculate the magnifications of the zoomable telecentric imaging sensor with the dimension calibration patterns, and correct the position of the XY stage movement. Third, we present a method of recovering high dynamic range radiance maps from photographs taken with the telecentric imaging equipment. In the method, multiple photographs of the device-under-test are taken with different amounts of exposure. The algorithm and the color characterization use those differently exposed photographs to recover the response function of the telecentric imaging processes, up to factor of scale, using the assumption of reciprocity. With the resultant response function, the algorithm can merge the multiple photographs into a single, high dynamic range radiance map whose pixel values are proportional to the true radiance values in the scene. The results revealed that acceptable levels of the color difference range from dim scene to bright scene. Forth, we demonstrate the method on images acquired with both micro-LED source and high-resolution display imaging processes. The paper discusses how the framework is applicable in many areas of computer vision involving image sensor calibration, including image-based color modeling, image compositing, and image processing. Lastly, the paper demonstrates a typical application of having high dynamic range radiance maps, such as synthesizing realistic HDR lighting system and simulating the performance of the micro-LED displays system.

Keywords: Color characterization, High dynamic range, Micro-imaging system

DETECTING AND FOLLOWING AN INDOOR TARGETED SUBJECT WITH DEVISED FLATTERY ILLUMINATION

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ABSTRACT

In the stage of different venues, such as speech, product launch, large conference or other large multiplayer, it is practically needed to have the mutual cooperation of lighting, cameras and audio-visual equipment to create a perfect event success. Additionally, to stimulate or strengthen both emotional resonance and visual perception of the audience in the scene, the color light illuminated on the stage should be intelligently adjusted or changed, according to different situations of the stage or speech-field or exhibition-venue be considered.

In this study, an application system, using "intelligent multi-camera tracking and monitoring with adjustable illuminated spot-light", was designed to find the "focal protagonist", using cameras considered, in complex scenes. The derived algorithm could carry out 1) to detect individual characters moving in the field; 2) to find the main hot-spot protagonist; and then, 3) to apply focus-light to follow the hot-spot protagonist in question. Simultaneously, the color, produced with the ambient lighting-source, having optimized color temperature, would be predicted. Moreover, according to inherent- or dominant-colors' appearance of the hot-spot protagonist's wears or dresses-up, the illuminated color would be intelligently adjusted and projected on the detected focus-character, With the practical value in the scene concerned, the so-called "on-the spot intelligent tracking of target character" was pleasingly and acceptably enhanced.

Keywords: Computer vision, Subject targeted, Object detection and identification, Color Rendering Index, Color Quality Scale

A STUDY OF WET-TO-DRY INK CHROMATIC AND DENSITY VARIATION WITH ISO 15339

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ABSTRACT

Due to branding customers' requirements, ISO, International Standard for Organizations, is a specification for printing industries to achieve printing quality that it is an irreversible trend. This research adopted coated and uncoated paper with ISO 15339 standard and analyzed the variation of saturation and density for wet-to-dry ink with paper from the domestic of printing material with ISO 2846 ink specification, and additionally the final influence of color accuracy from hue, value, and chroma. The variation and the characterization of wet-to-dry ink color and density adopted the formal lithography with the same ink and paper, the process sequentially used ink qualifier, ink proofer and handheld spectrophotometer to detect the density variation with wet and dry ink from the different ink film amounts, which correspond the dry ink saturation to match ISO 12647 standard. This research also showed the coated paper was less ink absorbency, under ISO 15339 CRPC6 standard, the process color ink CMYK must more notice the variation of wet-to-dry to black ink. However, the variation of CMY is not significant, when putting ink to control printing and adjustment. On the other hand, the uncoated paper absorbed more ink than that of coated paper, under ISO 15339 CRPC3 standard, the variation of wet-to dry process inks of CMYK is significantly different. Among them, the black ink was dramatically changed which influence on the final printing tone performance which could cause serious print quality obstacles. Regarding to the colorimetric analysis of Lightness (L*), Chroma (C*), and Hue angle (h°) of CMYK inks on coated and uncoated paper, the study showed that the LCh° of coated paper based on ISO 15339 CRPC6 specification were only slightly varied. However, the LCh° of uncoated paper based on ISO 15339 CRPC3 standard revealed a significant wet-to-dry colorimetric difference in terms of color quality issue. The CMYK inks on uncoated paper presented a lightness L raise a value of 8, a slight variation of chroma C, and a sever difference of hue angle h° of 26 degrees. With the study of wet-to-dry ink can completely imitate specific ink, paper and printing integration, also the final printing color performance. The difference of chroma and density was through wet-to-dry ink, which can immediately apply in printing process to control chroma and density of wet ink for predicting the final printing color. For checking color performance that finished to print.

Keywords: ISO 15339, color and density of wet-to-dry Ink, Color measurement and application, Color management

FACTORS AFFECTING ACCURACY OF CAMERA-BASED COLOR MEASUREMENT USING A REFERENCE COLOR CHART

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ABSTRACT

Camera is a useful tool for color measurement of flat surface. However, there are many factors affects the accuracy of the measurement such as illuminant metamerism, sensor metamerism, geometry metamerism, color enhancement of the camera and optical property of the surface. In this study, the effects of 5 factors including camera choice, substrate, light source, regression method and sample placement method were estimated. 3 cameras (including 1 DSLR and 2 mobile-phone cameras), 3 types of flat samples (matte paper, glossy paper and plastic chips in 3 mm depth), 4 light sources (D65/CWF/VVF/TL84), 3 color correction methods and 2 placement methods were tested. 24 color samples were photographed with a ColorChecker Proof attached on top of them. The experimental results show that the errors of direct color space conversion are quite large, with an average of more than 10 ΔE00. Using the color chart as a reference to assist color measurement can reduce the color differences to a half. The best color correction method is "color difference-weighted high-order linear regression". Due to the translucent nature of plastic color samples, it is necessary to compensate for "light leakage" in the XYZ color space to reduce color prediction errors. In terms of the effects of the camera, light source, substrate, and placement method, the results show that the performance of the cameras varies, but the differences are not big. Under the four tested light sources, D65 and CWF perform better, while TL84 performs the worst. Among the three type of substrate, colors of inkjet printing on matte paper are most predictable and stable, whereas colors of plastic samples are more unpredictable. For placing the plastic samples, lying flat mode is better than wall- mounting mode in the light booth. The results provide valuable guidelines for improving the accuracy of camera-based color measurement.

Keywords: Color measurement, mobile phone camera, color rendering chart, lighting environment, color correction, color metamerism

A PRINT QUALITY STUDY OF ISO 15339 IMPLEMENTATION AND QUALITY EVALUATION

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ABSTRACT

ISO 15339 specification is a method to join international world for markets, and a tool to achieve qualities for industries. Additionally, it is crucial whether Taiwan printing industries can undertake international branding orders. This study was to analyze various paper through lithography implemented the color difference of ISO standard, and to evaluate hue, value, and saturation for the impact conditions to print color quality. The study adopted Quasi-Experiment method and the lithographic printing process applied two types of paper, coated and uncoated paper. Totally, 31104 different CMYK combination patches plus 124416 color information were developed. Moreover, ISO 15339 showed the printing results under the conditions of CRPC6 and CRPC3. The D50 standard illuminance was used and the M1 standard to color measurement was applied. Finally, the printed patches were randomly selected and measured with eXact handheld spectrophotometer to acquire CIELAB color values. The results showed the average of color difference CIEDE2000 on CRPC6 (coated paper) was 1.89, and the average of color difference CIEDE2000 on CRPC3 (uncoated paper) was 3.61. In short, the overall printing color quality was excellent. There was various paper implemented ISO standard in color performance from lithography printing, and the printing color quality with coated paper achieved ISO 15339 quality Level A (the best quality), and the uncoated paper was about Level C, which was considered as OK. This research proved that Taiwan domestic printing techniques, paper and ink quality were all corresponded to international requirements. The final was to analyze lightness, saturation, and hue (LCh°) to color qualities of those print color swatches. The printing color swatches with coated paper met the standard of ISO15339 CRPC6, and was slightly unstable with color value L. The printing color swatches with uncoated paper also met ISO 15339 CRPC3, however, both chroma C and hue angle h° of color information needed to pay more attention. This research provided useful references for designing, printing, packaging industries and so on. Furthermore, it was proved that to implement printing color management to assist printing was effective.

Keywords: Printing color quality, ISO 15339, Color management, Color measurement and application

ENHANCE COLOR DENSITY AND DIGITAL WATERMARK GRADATION WITH MULTI-LEVEL INTAGLIO

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ABSTRACT

Intaglio printing is the main technology for security documents, and it is also a work of art. The lines of the traditional etched intaglio can be thick or thin, but the depths of the ink grooves are the same. In this study, in addition to keeping lines of different thicknesses, we set different parameters through digital files and engraved intaglio plates with variable depths through CTiP (Computer To intaglio Plate). When printing with CTiP plate, paper is placed on the plate and compressed by a heavy roller. Then the paper is removed, and the ink has been transferred from the plate (groove) to the paper. The ink on the paper is raised with tactile effect, the color density changes richly, and we call it multi-level intaglio. To identify multi-level intaglio documents, watermark is used as an identification method. But the watermark on the paper is an image formed by observing the density of the fibers through light transmission. However, the lighttransmitting method cannot be used for thick intaglio ink and paper. Therefore, in this study, the reflective-watermark method is proposed for the identification of the prints with multi-level intaglio. Take images of different focal planes at 2um height intervals via electron microscope. Connect the plane coordinates of 2D images with different focal planes and the corresponding height parameters into a 3D structure. Then it is rendered into multi-tone digital watermark image to judge the authenticity of the artwork.

If the ink thickness of multiple layers significantly affects the visual color density, we can adjust the width of the engraved lines to keep the color appearance consistent. It can make imitator unaware of the location of the watermark. The 3D watermark patterns after the color consistency adjustment can also be retrieved using the method proposed in this study.

Keywords: intaglio, microstructure, digital watermark, security document, color technology

NON-DESTRUCTIVE DETERMINATION OF PHOTOSYNTHETIC PIGMENTS IN LEAVES BASED ON COLOR MIXTURE THEORY

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ABSTRACT

The conventional chemical colorimetric method compares the absorbance or transmittance of the solution to be analyzed. A series of standard solutions of different concentrations have been prepared until the absorbance or transmittance of the unknown concentration solution is the same as that of a standard solution in the concentration of this unknown solution. Primary photosynthetic pigments in leaves contain chlorophyll a, chlorophyll b, carotenoids, and lutein. The conventional determination methods include rotten leaves, solution extraction, and chromatographic analysis. The chromatographic analysis employed affinity for solvents to photosynthetic pigments in leaves to produce the color spectrum solution in test strips or tubes. The full pre-calibrated spectrum of solution colors corresponding to the specific pigments would deduce the content of photosynthetic pigments based on the formula proposed by Aron et al. Obviously; this method is time-consuming, complicated, and destructive. By grabbing from the color leaf images, this study intends to calculate the content of each photosynthetic pigment which could predict the color leaf images based on color mixture theory and AI prediction model by the pre-calibrated color coordination in photosynthetic pigments. It is hoped that the content of each photosynthetic pigment in leaves can be determined by a simple, fast, accurate, and non-destructive method.

Keywords: Chromatography, Photosynthetic pigments, Color mixture theory

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