Lecture Notes in Networks and Systems 278

Leonard Barolli
Kangbin Yim
Tomoya Enokido *Editors*

Complex, Intelligent and Software Intensive Systems

Proceedings of the 15th International Conference on Complex, Intelligent and Software Intensive Systems (CISIS-2021)

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Welcome Message of CISIS-2021 International Conference Organizers

Welcome to the 15th International Conference on Complex, Intelligent and Software Intensive Systems (CISIS-2021), which will be held from July 1 to July 3, 2021, at Soon Chun Hyang (SCH) University, Asan, Korea, in conjunction with the 15th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2021).

The aim of the conference is to deliver a platform of scientific interaction between the three interwoven challenging areas of research and development of future ICT-enabled applications: software intensive systems, complex systems and intelligent systems.

Software intensive systems are systems, which heavily interact with other systems, sensors, actuators, devices, other software systems and users. More and more domains are involved with software intensive systems, e.g., automotive, telecommunication systems, embedded systems in general, industrial automation systems and business applications. Moreover, the outcome of web services delivers a new platform for enabling software intensive systems. The conference is thus focused on tools, practically relevant and theoretical foundations for engineering software intensive systems.

Complex systems research is focused on the overall understanding of systems rather than its components. Complex systems are very much characterized by the changing environments in which they act by their multiple internal and external interactions. They evolve and adapt through internal and external dynamic interactions.

The development of intelligent systems and agents, which is each time more characterized by the use of ontologies and their logical foundations, builds a fruitful impulse for both software intensive systems and complex systems. Recent research in the field of intelligent systems, robotics, neuroscience, artificial intelligence and cognitive sciences is a very important factor for the future development and innovation of software intensive and complex systems.

The CISIS-2021 is aiming at delivering a forum for in-depth scientific discussions among the three communities. The papers included in the proceedings cover all aspects of theory, design and application of complex systems, intelligent systems and software intensive systems.

We are very proud and honored to have two distinguished keynote talks by Dr. Jayh (Hyunhee) Park, Myongji University, Korea, and Dr. Antonio Esposito, University of Campania "Luigi Vanvitelli", Italy, who will present their recent work and will give new insights and ideas to the conference participants.

The organization of an international conference requires the support and help of many people. A lot of people have helped and worked hard to produce a successful CISIS-2021 technical program and conference proceedings. First, we would like to thank all the authors for submitting their papers, the program committee members and the reviewers who carried out the most difficult work by carefully evaluating the submitted papers. We are grateful to Honorary Co-Chairs Kyoil Suh, Soon Chun Hyang (SCH) University, Korea, and Prof. Makoto Takizawa, Hosei University, Japan, for their guidance and advices.

Finally, we would like to thank Web Administrator Co-Chairs for their excellent and timely work.

We hope you will enjoy the conference proceedings.

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CISIS-2021 Keynote Talks

Asking AI Why: Explainable Artificial Intelligence

Jayh (Hyunhee) Park

Myongji University, Yongin, Korea

Abstract. In the early phases of AI adoption, it was okay to not understand what the model predicts in a certain way, as long as it gives the correct outputs. Explaining how they work was not the first priority. Now, the focus is turning to build human interpretable models. In the invited talk, I will explain why explainable AI is important. Then, I will explain an AI model. Through this invited talk, I will discuss models such as ensembles and neural networks called black-box models. I will deal with the following questions.

- Why should we trust your model?
- Why did the model take a certain decision?
- What drives model predictions?

Coevolution of Semantic and Blockchain Technologies

Antonio Esposito

University of Campania “Luigi Vanvitelli”, Aversa, Italy

Abstract. Semantic technologies have demonstrated to have the capability to ease interoperability and portability issues in several application fields such as cloud computing and the Internet of things (IoT). Indeed, the increase in resource representation and the inference capabilities enabled by semantic technologies represent important components of current distributed software systems, which can rely on better information interoperability and decision autonomy. However, semantics alone cannot solve trust and reliability issues that, in many situations, can still arise within software systems. Blockchain solutions have shown to be effective in this area, creating data sharing infrastructure where information validation can be done without the necessity of third-party services. A coevolution and integration of semantic and blockchain technologies would at the same time enhance data interoperability and ensure data trust and provenance, creating undeniable benefits for distributes software systems. This talk will focus on the current state of the art regarding the integration of semantic and blockchain technologies, looking at the state of their coevolution, at the available and still needed solutions.

Contents

Four Grade Levels-Based Models with Random Forest for Student Performance Prediction at a Multidisciplinary University 1
Tran Thanh Dien, Le Duy-Anh, Nguyen Hong-Phat, Nguyen Van-Tuan, Trinh Thanh-Chanh, Le Minh-Bang, Nguyen Thanh-Hai, and Nguyen Thai-Nghe

The Role of Collective Engagement to Strengthen Organizational Identity 13
Olivia Fachrunnisa, Ardian Adhiatma, and Ken Sudarti

A Novel Structural and Semantic Similarity in Social Recommender Systems 23
Imen Ben El Kouni, Wafa Karoui, and Lotfi Ben Romdhane

Trustworthy Explainability Acceptance: A New Metric to Measure the Trustworthiness of Interpretable AI Medical Diagnostic Systems . . . 35
Davinder Kaur, Suleyman Uslu, Arjan Durresi, Sunil Badve, and Murat Dundar

Entity Relation Extraction Based on Multi-attention Mechanism and BiGRU Network 47
Lingyun Wang, Caiquan Xiong, Wenxiang Xu, and Song Lin

Time Series Prediction of Wind Speed Based on SARIMA and LSTM 57
Caiquan Xiong, Congcong Yu, Xiaohui Gu, and Shiqiang Xu

Dimensionality Reduction on Metagenomic Data with Recursive Feature Elimination 68
Huong Hoang Luong, Nghia Trong Le Phan, Tin Tri Duong, Thuan Minh Dang, Tong Duc Nguyen, and Hai Thanh Nguyen

The Application of Improved Grasshopper Optimization Algorithm to Flight Delay Prediction–Based on Spark 80
Hongwei Chen, Shenghong Tu, and Hui Xu

Application of Distributed Seagull Optimization Improved Algorithm in Sentiment Tendency Prediction 90
Hongwei Chen, Honglin Zhou, Meiying Li, Hui Xu, and Xun Zhou

Performance Evaluation of WMNs by WMN-PSOSA-DGA Hybrid Simulation System Considering Stadium Distribution of Mesh Clients and Different Number of Mesh Routers 100
Admir Barolli, Shinji Sakamoto, Leonard Barolli, and Makoto Takizawa

A New Scheme for Slice Overloading Cost in 5G Wireless Networks Considering Fuzzy Logic 110
Phudit Ampririt, Ermioni Qafzezi, Kevin Bylykbashi, Makoto Ikeda, Keita Matsuo, and Leonard Barolli

COVID-Prevention-Based Parking with Risk Factor Computation 121
Walter Balzano and Silvia Stranieri

Coarse Traffic Classification for High-Bandwidth Connections in a Computer Network Using Deep Learning Techniques 131
Marek Bolanowski, Andrzej Paszkiewicz, and Bartosz Rumak

A Privacy Preserving Hybrid Blockchain Based Announcement Scheme for Vehicular Energy Network 142
Abid Jamal, Sana Amjad, Usman Aziz, Muhammad Usman Gurmani, Saba Awan, and Nadeem Javaid

Prediction of Wide Area Road State Using Measurement Sensor Data and Meteorological Mesh Data 152
Yoshitaka Shibata and Akira Sakuraba

A Coverage Construction and Hill Climbing Approach for Mesh Router Placement Optimization: Simulation Results for Different Number of Mesh Routers and Instances Considering Normal Distribution of Mesh Clients 161
Aoto Hirata, Tetsuya Oda, Nobuki Saito, Yuki Nagai, Masaharu Hirota, Kengo Katayama, and Leonard Barolli

Related Entity Expansion and Ranking Using Knowledge Graph 172
Ryuya Akase, Hiroto Kawabata, Akiomi Nishida, Yuki Tanaka, and Tamaki Kaminaga

Zero Trust Security in the Mist Architecture 185
Minoru Uehara

Blockchain Based Authentication for End-Nodes and Efficient Cluster Head Selection in Wireless Sensor Networks 195
Sana Amjad, Usman Aziz, Muhammad Usman Gurmani, Saba Awan, Maimoona Bint E. Sajid, and Nadeem Javaid

The Redundant Active Time-Based Algorithm with Forcing Meaningless Replica to Terminate 206
Tomoya Enokido, Dilawaer Duolikun, and Makoto Takizawa

A Novel Approach to Network's Topology Evolution and Robustness Optimization of Scale Free Networks 214
Muhammad Usman, Nadeem Javaid, Syed Minhal Abbas, Muhammad Mohsin Javed, Muhammad Aqib Waseem, and Muhammad Owais

Implementation of an Indoor Position Detecting System Using Mean BLE RSSI for Moving Omnidirectional Access Point Robot 225
Atushi Toyama, Kenshiro Mitsugi, Keita Matsuo, Elis Kulla, and Leonard Barolli

A Survey on Internet of Things in Telehealth 235
Komal Marwah and Farshid Hajati

Alexnet-Adaboost-ABC Based Hybrid Neural Network for Electricity Theft Detection in Smart Grids 249
Muhammad Asif, Ashraf Ullah, Shoaib Munawar, Benish Kabir, Pamir, Adil Khan, and Nadeem Javaid

Blockchain and IPFS Based Service Model for the Internet of Things 259
Hajra Zareen, Saba Awan, Maimoona Bint E Sajid, Shakira Musa Baig, Muhammad Faisal, and Nadeem Javaid

Building Social Relationship Skill in Digital Work Design 271
Ardian Adhiatma and Umi Kuswatun Hasanah

How to Push Digital Ecosystem to Explore Digital Humanities and Collaboration of SMEs 279
Marno Nugroho and Budhi Cahyono

IOTA-Based Mobile Application for Environmental Sensor Data Visualization 288
Francesco Lubrano, Fabrizio Bertone, Giuseppe Caragnano, and Olivier Terzo

Electricity Theft Detection in Smart Meters Using a Hybrid Bi-directional GRU Bi-directional LSTM Model 297
Shoaib Munawar, Muhammad Asif, Beenish Kabir, Pamir, Ashraf Ullah, and Nadeem Javaid

Developing Innovation Capability to Improve Marketing Performance in Batik SMEs During the Covid-19 Pandemic 309
Alifah Ratnawati and Noor Kholis

Muthmai'nnah Adaptive Capability: A Conceptual Review 324
Asih Niati, Olivia Fachrunnisa, and Mohamad Sodikin

Interaction Model of Knowledge Management, Green Innovation and Corporate Sustainable Development in Indonesia 332
Siti Sumiati, Sri Wahyuni Ratnasari, and Erni Yuvitasari

The Impact of Covid-19 Pandemic on Continuance Adoption of Mobile Payments: A Conceptual Framework 338
Dian Essa Nugrahini and Ahmad Hijri Alfian

An Analysis in the Application of the Unified Theory of Acceptance and Use of Technology (UTAUT) Model on Village Fund System (SISKEUDES) with Islamic Work Ethics as a Moderating Effect 347
Khoirul Fuad, Winarsih, Luluk Muhimatul Ifada, Hendry Setyawan, and Retno Tri Handayani

MOC Approach and Its Integration with Social Network and ICT: The Role to Improve Knowledge Transfer 357
Tri Wikaningrum

An Integrated System for Actor Node Selection in WSANs Considering Fuzzy Logic and NS-3 and Its Performance Evaluation . . . 365
Yi Liu, Shinji Sakamoto, and Leonard Barolli

Design of an Intelligent Driving Support System for Detecting Distracted Driving 377
Masahiro Miwata, Mitsuki Tsuneyoshi, Yoshiki Tada, Makoto Ikeda, and Leonard Barolli

Detection of Non-Technical Losses Using MLP-GRU Based Neural Network to Secure Smart Grids 383
Benish Kabir, Pamir, Ashraf Ullah, Shoaib Munawar, Muhammad Asif, and Nadeem Javaid

Synthetic Theft Attacks Implementation for Data Balancing and a Gated Recurrent Unit Based Electricity Theft Detection in Smart Grids 395
Pamir, Ashraf Ullah, Shoaib Munawar, Muhammad Asif, Benish Kabir, and Nadeem Javaid

Blockchain Enabled Secure and Efficient Reputation Management for Vehicular Energy Network 406
Abid Jamal, Muhammad Usman Gurmani, Saba Awan, Maimoona Bint E. Sajid, Sana Amjad, and Nadeem Javaid

Religious Value Co-Creation: A Strategy to Strengthen Customer Engagement 417
Ken Sudarti, Olivia Fachrunnisa, Hendar, and Ardian Adhiatma

Environmental Performance Announcement and Shareholder Value: The Role of Environmental Disclosure 426
Luluk Muhimatul Ifada, Munawaroh, Indri Kartika, and Khoirul Fuad

Integrating Corporate Social Responsibility Disclosure and Environmental Performance for Firm Value: An Indonesia Study 435
Maya Indriastuti and Anis Chariri

Financial Technology and Islamic Mutual Funds Investment 446
Mutamimah and Rima Yulia Sueztianingrum

Towards Spiritual Wellbeing in Organization: Linking Ihsan Achievement Oriented Leadership and Knowledge Sharing Behaviour 455
Mohamad Sodikin, Olivia Fachrunnisa, and Asih Niati

Tax Avoidance and Performance: Initial Public Offering 464
Kiryanto, Mutoharoh, and Zaenudin

Knowledge Sharing, Innovation Strategy and Innovation Capability: A Systematic Literature Review 473
Mufti Agung Wibowo, Widodo, Olivia Fachrunnisa, Ardian Adhiatma, Marno Nugroho, and Yulianto Prabowo

The Determinant of Sustainable Performance in Indonesian Islamic Microfinance: Role of Accounting Information System and Maqashid Sharia 484
Provita Wijayanti and Intan Salwani Mohamed

The Role of Digital Utilization in Accounting to Enhance MSMEs' Performance During COVID-19 Pandemic: Case Study in Semarang, Central Java, Indonesia 495
Hani Werdi Apriyanti and Erni Yuvitasari

The Role of Confidence in Knowledge and Psychological Safety on Knowledge Sharing Improvement of Human Resources in Organization 505
Arizqi

A Model of Agency Theory-Based Firm Value Improvement Through Cash Holding with Firm Size and Profitability as Control Variable 514
Ibnu Khajar and Ayu Rakhmawati Kusumaningtyas

The Model of Tax Compliance Assessment in MSMEs 524
Devi Permatasari, Naila Najihah, and Mutoharoh

Survival and Sustainability Strategies of Small and Medium Enterprises (SMEs) During and After Covid-19 Pandemic: A Conceptual Framework 534
Naila Najihah, Devi Permatasari, and Mutoharoh

Bridging the Semantic Gap in Continuous Auditing Knowledge Representation 544
Sri Sulistyowati, Indri Kartika, Imam Setijawan, and Maya Indriastuti

Comparison of Financing Resources to Support Micro and Small Business Sustainability 555
Mutoharoh, Devi Permatasari, and Naila Najihah

The Mediating of Green Product Innovation on the Effect of Accounting Capability and Performance Financial of MSMEs in the New Normal Era 565
Winarsih, Khoirul Fuad, and Hendri Setyawan

Supply Chain Management Quality Improvement Model with Adaptive and Generative Relationship Learning 573
Lutfi Nurcholis and Ardian Adhiatma

Company's Characteristics and Intellectual Capital Disclosure: Empirical Study at Technology Companies of Singapore 580
Dista Amalia Arifah, Anis Chariri, and Pujiharto

The Influence of Sustainability Report on Islamic Banking Performance in Indonesia 590
Muhammad Jafar Shodiq

The Antecedent and Consequences of Commitment to the Environment in Environmentally Friendly Automotive Products 598
Tanti Handriana, Praptini Yulianti, and Decman Praharsa

Towards a Trustworthy Semantic-Aware Marketplace for Interoperable Cloud Services 606
Emanuele Bellini, Stelvio Cimato, Ernesto Damiani, Beniamino Di Martino, and Antonio Esposito

Toward ECListener: An Unsurpervised Intelligent System to Monitor Energy Communities 616
Gregorio D'Agostino, Alberto Tofani, Beniamino Di Martino, and Fiammetta Marulli

Semantic Techniques for IoT Sensing and eHealth Training Recommendations 627
Beniamino Di Martino and Serena Angela Gracco

PrettyTags: An Open-Source Tool for Easy and Customizable Textual MultiLevel Semantic Annotations 636
Beniamino Di Martino, Fiammetta Marulli, Mariangela Graziano, and Pietro Lupi

Supporting the Optimization of Temporal Key Performance Indicators of Italian Courts of Justice with OLAP Techniques 646
Beniamino Di Martino, Luigi Colucci Cante, Antonio Esposito, Pietro Lupi, and Massimo Orlando

Semantic Techniques for Automated Recognition of Building Types in Cultural Heritage Domain 657
Beniamino Di Martino, Mariangela Graziano, and Nicla Cerullo

Semantic Representation and Rule Based Patterns Discovery and Verification in eProcurement Business Processes for eGovernment 667
Beniamino Di Martino, Datiana Cascone, Luigi Colucci Cante, and Antonio Esposito

Research on the Development of Programming Support Systems Focused on the Cooperation Between Activity Diagrams and Scratch 677
Kazuhiro Kobashi, Kazuaki Yoshihara, and Kenzi Watanabe

Research on the Development of Keyboard Applications for Reasonable Accommodation 686
Reika Okuya, Kazuaki Yoshihara, and Kenzi Watanabe

Development of a Teaching Material for Information Security that Detects an Unsecure Wi-Fi Access Point 694
Kazuaki Yoshihara, Taisei Iwasaki, and Kenzi Watanabe

A Study of Throughput Drop Estimation Model for Concurrently Communicating Links Under Coexistence of Channel Bonding and Non-bonding in IEEE 802.11n WLAN 700
Kwenga Ismael Munene, Nobuo Funabiki, Hendy Briantoro, Md. Mahbubur Rahman, Sujan Chandra Roy, and Minoru Kuribayashi

Dynamic Fog Configuration for Content Sharing with Peer-to-Peer Network Using Mobile Terminals in a City 715
Takuya Itokazu and Shinji Sugawara

Voice Quality Change Due to the Amount of Training Data for Multi- and Target-Speaker WaveNet Vocoders 727
Satoshi Yoshida, Shingo Uenohara, Keisuke Nishijima, and Ken'ichi Furuya

Web-Based Collaborative VR Training System and Its Log Functionality for Radiation Therapy Device Operations 734
Yuta Miyahara, Kosuke Kaneko, Toshioh Fujibuchi, and Yoshihiro Okada

Action Input Interface of *IntelligentBox* Using 360-Degree VR Camera and OpenPose for Multi-persons' Collaborative VR Applications 747
Bai Yu, Wei Shi, and Yoshihiro Okada

Author Index 759

Building Social Relationship Skill in Digital Work Design

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Abstract. The aim of this study is to analyze the impact of digital work design on social relationship skill through Digital-Mediated Communication (DMC) for learning methods in the digital era. This study presents how to improve social relationship skill for university lectures. Data were collected by using questionnaire techniques with SmartPLS as the analysis tool. The result found that all hypotheses are confirmed. The Implementation of DMC not only improves social relationship skill but also improve the virtual empathy that rarely appear during digital interaction. The model of social relationship skill improvement through DMC and digital work design can be used by researchers and practitioners to study and achieve the future in various organizations.

Keywords: Digital work design · Digital-mediated communication · Communication skills · Relationship quality · Empathy

1 Introduction

The development of digital technology is growing rapidly in all lines of life, including in the world of work. In the revolution era, digitalization can change the previous business environment [1]. Work design must always keep up with all the social, cultural and political changes and challenges in the business environment. During the current Covid-19 pandemic for instance, all organizations are required to continue to improve business strategies including work designs that has been adapted to various unstable conditions. The organization management continues to strive so that its business can survive amid the outbreak. It includes universities, which are currently deciding to use e-learning for their teaching and learning activities.

Digital work design follows the need for blended learning which is currently being used as a student learning method in the midst of a pandemic. As an education-based service, universities must be able to prepare future generations with better quality than the previous generation. Digital intelligence is defined as the sum of social, emotional, and cognitive skills that enable people to face challenges and adapt to the requirements of digital life [2]. Therefore, the lecturers do not only need to understand technology but also should social relationship skill. This skill aims to make delivery of material, knowledge, and values from lecturers can be well-received through direct communication skills or digital tools. This intelligence includes skills how to establish good

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communication, maintain a quality relationship with colleagues, control emotions, give empathy or motivation with today's digital environment.

This intelligence includes how to establish good communication, maintain a quality relationship with colleagues, control emotions, give empathy or motivation with today's digital environment. DMC is defined as communication mediated by interconnected computers, between individuals or groups separated in space and/or time [3]. The use of digital tools in communication is crucial for collaboration between lecturers in the digital era and the current pandemic era. This skill is also very important for transferring knowledge to students through e-learning, online discussions, and sending virtual assignments.

This study examines the relationship of digital work design (DWD) to improve communication skills, relationship quality, and empathy mediated by digital-mediated communication (DMC) in higher educational institutions. The samples of this study were lecturers who are digital immigrants (born before 1985). It means they were born before the advent of the digital era. Changes in the digital era also change work design so that it needs relational skills. Relational skills are basically difficult collaborate automatically in completing work which can be applied in educational institutions [4]. One of the efforts to improve relational skills in organizations is achieved by adopting a DMC that can be implemented both in the workplace and outside the workplace.

2 Literature Review and Hypothesis Development

2.1 Digital Work Design and Digital Mediated Communication

Digital work design (DWD) is a working design that connects human and computer interactions in work practices [5]. Many organizations have taken advantage of digital technology development to communicate through digital communication intermediaries mediated in virtual meetings with some of their colleagues. This is in line with Yee [6] research, that the workforce develops new ways of working by utilizing the full capabilities of digital technology. The adoption of digital work design in the workforce is now driving digital mediated communication. The implementation of digital work design in several organizations makes the workforce communicate through digital mediated communication such as WhatsApp groups, lines, Facebook, and others which are used to complete their work.

H1: Digital work design has a significant effect on the implementation of digital mediated communication.

2.2 Digital Mediated Communication on Communication Skill, Relationship Quality and Empathy

According to Dery and MacCormick [7], there there have been many changes in the digital workplace from 2006 to 2012.The changes are such as the work done by the workforce is always connected to the value of technology in the workplace which has led to the emergence of digital mediated communication. Meanwhile, according to Tarafdar et al. [8], the use of digital technology including DMC by employees must

have the support and control of managers. Moreover, Lau [9] suggested that DMC includes IM, can improve active control and two-way communication with good communication skills. As the result, it can improve good communication skills and increase team satisfaction Ou et al. [10]. The development of many workplaces that adopt DMCs allows for effective communication between colleagues in the workplace, both directly and virtually.

Meanwhile, Sharma [11] explained that the use of digital technology can form social network in organizations. It also can improve organizational performance and relationships quality. A research by Buckley et al. [12] shows that communication between employees through digital mediated communication, that is well connected, encourages employees to share information about problems and business processes so that it results quality relationships among other workers. Kane [13] stated that social media application in digital mediated communication is something that can help the internal collaboration and the relationships quality for individual interactions with other workers.

The role of technology in the digital eramust be able to make humans have good quality attitudes. Rushkoff [14] asked people to rethink the relationship between technology and humans. He stated that technology should support humanity and not the other way around. Batson [15] suggested the definition of empathy as abilities and processes; social information processing theory which describe the difference between face-to-face, computer-mediated communication also digital and media literacy [16]. Empathy can be created from social, emotional, and cognitive development both offline and online space. Research by Caplan & Turner [17] states that DMC, includes sharing experiences, themes, or interests, such as in online, support communities to have an empathic relationships that may be physically impossible. Likewise, the use of DMCs in an organization certainly presents social developments between one another that triggers the growth of empathy.

H2: Digital mediated communication implementation has a significant positive effect on communication skill.
H3: Digital mediated communication has a significant positive effect on relationship quality.
H4: Digital mediated communication has a significant positive effect on empathy.

2.3 Mediation Role of Digital Mediated Communication

The fact that society becomes increasingly dependent on digital systems means there is a special need to investigate how mediation operates in the field of communication. Hancock [18] proposed the concept of Artificial Intelligence-Mediated Communication (AI-MC) and discussed its incorporation in interpersonal communication. They described AI-MC as communication that is not only transmitted via technology, but also communication that is "modified, augmented, or even generated by computing agents to achieve communication goals". They added that AI-MC will play a role in linguistic patterns and relational dynamics, and ultimately in policy, culture, and ethics. DMC is closely related to social and interpersonal relationships including

communication, the quality of relationships that arise from interactions through technology, and the growth of empathy that results from sharing between workers with one another (Fig. 1).

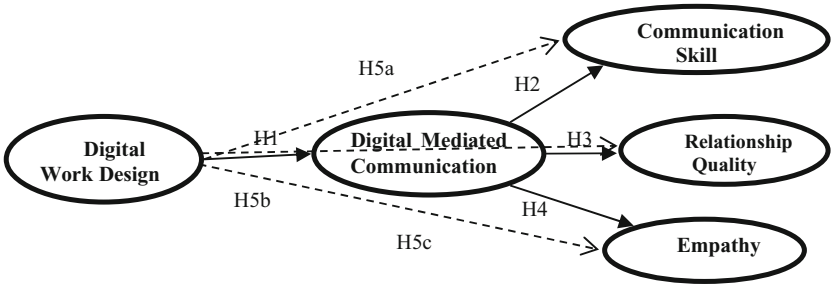

Fig. 1. Research Model

H5a: Digital mediated communication mediates the relationship between digital work design and communication skills
H5b: Digital mediated communication mediates the relationship between digital work design and relationship quality
H5c: Digital mediated communication mediates the relationship between digital work design and empathy

3 Method

The respondents of this study were lecturers who were digital immigrants at a university, totaling 100 lecturers using the purposive sampling technique. Lecturer profession was chosen as the sample because immigrant digital lecturers generation to always upgrade their digital abilities. It is an order to keep up with millennial generation students and have good relationship skill to transfer knowledge, and values. The data were collected through a questionnaire and processed using SmartPLS. There were 150 questionnaires given and 100 questionnaires were returned (66.67%). The result showed that the majority (58 lecturers) were dominated by men. From the level of education, the majority of respondents (88 lecturers) were postgraduate. Meanwhile, in term of age, majority respondent aged 40–40 years. The variables in this study are Digital Work Design (DWD) which includes 3 items, namely design for flexibility, agility & participation, and interdisciplinary, adopted from [5]. Digital Mediated Communication (DMC), includes 3 items, namely communication via email, communication through social media groups, and communication through virtual meetings, adopted from [19]. Communication Skill (CS), includes 8 indicators are obtained from Meerah et al. [20], namely communication skills to complete work orally, communication skills to complete work textually, communication skills for jobs completed with

body language (non-verbal), the ability to give feedback in communicating with others verbally, and the ability to give feedback in communicating with others textually. Relationship Quality (RQ), with 5 indicators, namely emotional support (emotions expressed authentically and constructively), tension or resilience, and openness; as well as positive emotional experiences, and mutuality [21]. All variables are measured by using Likert scale 1–5. The result of measurement model test based on Hair et al. [22] showed that all variables have fulfilled reliability and validity (Tables 1 and 2).

Table 1. The Reliability Analysis of the model's constructs

Variables	Composite reliability (CR): pc > 0.6	Cronbach's alpha: $\alpha > 0.7$	Average variance extracted (AVE): 0.5 > AVE
DWD	0.848	0.732	0.651
DMC	0.835	0.707	0.631
CS	0.844	0.771	0.520
RQ	0.872	0.833	0.578
Em	0.839	0.757	0.571

4 Result and Discussion

Diamantopoulos, Riefler, & Roth [23], categorized the path coefficient of < 0.30 as moderate cause (effect), from 0.30 to 0.60 as strong, and > 0.60 as very strong. Hypothesis test results show that all hypotheses are accepted (Table 3).

The direct effect of Digital Work Design (DWC) on Digital Mediated Communication DMC, Customer Satisfaction (CS), Relationship Quality (RQ), and Empathy (Em) shows that there is a strong direct effect. In other word, hypothesis 1, 2, 3, and are accepted. This in line with the research by Yee [6] stated that adoption ability of digital work design in the workforce is now driving digital mediated communication. Moreover, result of this study also support [9]. Digital mediated communication includes IM, can improve control and better communication skills. Social media usage in digital mediated communication can help the quality of individual interaction with other workers. Moreover, digital mediated communication enable sharing experiences, themes or interests, such as in online, support communities to have an empathic relationships that may be physically impossible. This hypothesis test results show that the higher level of digital work design, the higher the digital mediated communication, customer satisfaction and empathy for university professional lecturers. In this research the ability of high educational organization in managing digital work design in be able to improve their digital mediated communication, customer satisfaction, relationship quality and empathy of their professional lecturers.

Furthermore, DMC has a mediating role at a moderate level of the relationship between Digital Work Design (DWD) on Customer Satisfaction (CS), Relationship Quality (RQ) and Empathy (Em). This finding support Hancock et al. [18], proposed that Artificial Intelligence-Mediated Communication (AI-MC) and discussed its

Table 2. The result of model's validity

Construct indicator	Convergent validity	Discriminant validity
	Loadings > 0.70	HTMT < 1
Digital work design		
DWD1	0.776	
DWD2	0.833	Yes
DWD3	0.811	
Digital mediated communication		
DMC1	0.805	
DMC2	0.888	Yes
DMC3	0.674	
Communication skill		
CS1	0.694	
CS2	0.750	
CS3	0.749	Yes
CS4	0.652	
CS5	0.755	
Relationship quality		
RQ1	0.742	
RQ2	0.878	Yes
RQ3	0.723	
RQ4	0.694	
RQ5	0.750	
Empathy		
Em1	0.612	
Em2	0.858	Yes
Em3	0.861	
Em4	0.659	

Table 3. The Reliability Analysis of the model's constructs

Hypothesis	Beta	T-value (Sign)
H1: DWD  DMC	0.421	5.473***
H2: DMC  CS	0.364	4.353***
H3: DMC  RQ	0.377	4.675***
H4: DMC  Em	0.378	5.109***
H5a: DWD  DMC  CS	0.153	2.904***
H5b: DWD  DMC  RQ	0.159	3.424***
H5c: DWD  DMC  Em	0.159	3.172***
***p < 0.05		

incorporation in interpersonal communication. DMC is closely related to social and interpersonal relationship including communication, the quality of relationship that arise from interactions through technology, and the growth of empathy that results from sharing between professional lecturers with another.

5 Conclusion, Implication and Future Research

In conclusion, the implementation of DWD in universities can improve the quality of social relationship skills between lecturers through the mediating role of DMC variable. The use of digital communication provides opportunities effective communication and it improves the quality of relationships between one another in an interaction. DMC is also proven to be able to bridge the emergence of empathy to understand the conditions of others even though the interactions are virtual. Lecturers can form a network of relationships that are generated through the digital communication process because of a demand in the digital era that must always follow adjustments.

This research provides a theoretical contribution in form of discussion for social relationship skill in the context of digital work design in the organizational behavior and human resource management literature. The study of digital empathy is still very limited in the existing literature. This research proves that digital work design and digital mediated communication will create digital empathy. Research on digital empathy by Kano & Morita [24] focuses more on the empathy quotient by virtual agents. Meanwhile, in this study, empathy is shown by the support and motivation provided by each other through the DMC intermediary.

This study has several weaknesses, including data collection using questionnaires that cause self-report bias. The use of questionnaires also resulted in a lack of in-depth information regarding the actual situation. For the future research agenda, it is expected to increase in the number of respondents and a wider place of research by using the interview method to obtain broader information. The test for the future agenda is suggested to include other variables such as digital empathy which is in line with the current digital era as well as respondents who are included in the digital native category. The addition of variables in relational relationships such as collaboration also can be included.

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