



INTERNATIONAL CONFERENCE ON COMPUTING, INFORMATION SCIENCES AND TECHNOLOGY (ICCIST2026)

**Harnessing Emerging Technologies
for Sustainable Development: Innovative
Solutions for a Changing World**

 Mars 25th, 2026

 Kigali, Classic Hotel

Introduction

The rapid advancement of emerging technologies such as Internet of Things (IoT), Artificial Intelligence (AI), cloud computing, blockchain, and advanced wireless networks is fundamentally reshaping economies, societies, and development pathways worldwide. In the context of sustainable development, these technologies offer unprecedented opportunities to address complex challenges related to economic growth, social inclusion, environmental protection, and institutional efficiency. For developing countries, particularly in Africa, leveraging emerging technologies is no longer optional it is a strategic imperative for achieving resilient, inclusive, and sustainable futures.

AI and IoT stand at the forefront of this technological transformation. AI-driven systems enable intelligent decision-making, predictive analytics, automation, and optimization across sectors such as agriculture, healthcare, finance, education, and governance. IoT complements this by enabling real-time data collection through interconnected sensors and devices, supporting smart infrastructure, environmental monitoring, precision agriculture, energy management, and urban planning. When combined, AI and IoT create powerful ecosystems capable of improving service delivery, enhancing productivity, reducing resource waste, and strengthening evidence-based policymaking.

In Africa, where development challenges intersect with rapid population growth, climate vulnerability, limited infrastructure, and skills gaps, emerging technologies present both opportunities and responsibilities. Digital solutions can support climate-smart agriculture, strengthen cybersecurity, expand financial inclusion through digital finance, improve public service delivery, and foster innovation-driven entrepreneurship. However, these benefits can only be realized if issues of digital equity, ethical governance, cybersecurity, data privacy, capacity building, and sustainability are adequately addressed.

Against this backdrop, the conference on Emerging Technologies for Sustainable Development, scheduled for March 24–25, 2026 at the University of Lay Adventists of Kigali (UNILAK), provides a timely and strategic platform for interdisciplinary engagement. The hybrid format ensures broad participation from local, regional, and international stakeholders, fostering inclusive dialogue and global knowledge exchange. The conference brings together researchers, industry experts, policymakers, innovators, and students to critically examine how computing and information technologies can be harnessed to drive sustainable digital transformation, particularly within the African context.

Through its diverse thematic tracks including Artificial Intelligence, Cybersecurity, Blockchain, Cloud Computing, IoT, Wireless Networks, and Sustainable Computing the

conference emphasizes innovation that is not only technologically advanced but also ethically grounded, environmentally responsible, and socially inclusive. By highlighting cutting-edge research, real-world case studies, and practical solutions, the conference seeks to bridge the gap between theory and practice while strengthening collaboration between academia, industry, and government.

Ultimately, this conference aims to contribute to a shared vision where emerging technologies serve as enablers of sustainable development supporting resilient systems, inclusive growth, and long-term socio-economic transformation for Rwanda, Africa, and the global community.

Welcome Message from the Chairperson/ Organizing Committee



Prof. Jean NGAMIJE
Vice Chancellor, UNILAK

Guest of Honor, Distinguished Participants
and, Delegates, Ladies and Gentleman,

On behalf of the Organizing Committee, it is with great honor and pleasure that I welcome you to the **International Conference on Computing, Information Sciences, and Technology (ICCIST 2026)**, proudly hosted by the **University of Lay Adventists of Kigali (UNILAK)**.

The theme of this year's conference, **"Harnessing Emerging Technologies for Sustainable Development: Innovative Solutions for a Changing World,"** is both timely and highly relevant. In an era characterized by rapid digital transformation, climate change, cybersecurity threats, and evolving socio-economic challenges, emerging technologies are playing a critical role in shaping sustainable and resilient societies.

Across Rwanda, Africa, and the global community, advances in **Artificial Intelligence, Internet of Things, Cloud and Edge Computing, Blockchain, Wireless Networks, and Sustainable Computing** are transforming how we live, work, and govern. These technologies offer powerful tools for addressing pressing development challenges, enhancing efficiency, strengthening security, improving service delivery, and promoting inclusive economic growth. However, they also raise important concerns related to ethics, privacy, digital inclusion, skills gaps, and long-term sustainability.

Capacity building remains a cornerstone of sustainable technological progress. Continuous investment in education, research, innovation, and skills development is essential to empower researchers, practitioners, and policymakers to effectively design, deploy, and govern emerging technologies. UNILAK, together with its national and international partners, is uniquely positioned to contribute to this mission by fostering research excellence and knowledge exchange.

Innovation lies at the heart of ICCIST 2026. From AI-driven solutions for social good and smart cities enabled by IoT, to secure cloud infrastructures, blockchain-based financial technologies, and green computing solutions, this conference emphasizes practical, forward-looking innovations that respond to real-world challenges.

Inclusiveness is equally critical. Sustainable digital transformation must ensure that no one is left behind. By promoting access, participation, and representation particularly for young researchers, women, and innovators from developing regions ICCIST 2026 seeks to build a more equitable and collaborative global research community.

Finally, **sustainability** must guide all technological advancements. Environmentally responsible computing, energy-efficient systems, and ICT solutions for development are essential to ensuring that technological progress supports long-term social, economic, and environmental well-being.

UNILAK remains firmly committed to advancing sustainable computing and digital innovation through research, training, and collaborative platforms such as this conference. Throughout this day, I encourage all participants to actively engage in discussions, share insights, and build partnerships that translate research into impactful solutions.

I extend my sincere gratitude to the Organizing Committee, our sponsors, partners, and all participants for their dedication and invaluable contributions toward the success of **ICCIST2026**. Your participation enriches the conference, and I look forward to the stimulating discussions and innovative ideas that will emerge.

Once again, welcome to **ICCIST2026**. Let us embark together on this journey of knowledge, collaboration, and innovation for sustainable development.

Professor Jean Ngamije.

Vice Chancellor

University of Lay Adventist of Kigali,

Key Note Speaker



Dr. G.O. Ouma Mak'Ouma
Co-founded Sevenett Ltd

G.O. Ouma Mak'Ouma is a tech entrepreneur, academician, and community leader committed to driving innovation and collaboration. He began his career as a teacher and lecturer in Kenya, bringing a strong foundation in education to his work. With over a decade of experience, he co-founded *Sevenett Ltd*, igniting his passion for technology and entrepreneurship.

Currently living in the USA with his family, He founded *Sevenett LLC*, which empowers African communities by creating career pathways in tech through training programs in AI, data analytics, data science, and coding. He also serves as the Board Chairman of the *Kenya-USA Tech Forum (KUSAT)*, an initiative focused on connecting global talent through technology, driving innovation, shaping the future of AI, and strengthening diaspora engagement. In addition, he founded *NaviSmart AI*, a cutting-edge platform that leverages AI to simplify and streamline immigration process.

Ouma's memoir *Resilience Beyond Throes* chronicles his journey from childhood trauma to triumph, driven by resilience and a desire to inspire others. It's a powerful testament to turning adversity into purpose and limitless dreams.

His academic credentials include a Ph.D. in Information Systems, an MBA and a bachelor's in business information technology (BBIT), and a Diploma in ICT.

<https://www.linkedin.com/in/geoffreyouma/>

Key Note Speaker



Prof. NYESHEJA M. Enan

Dean, Faculty of Computing and Information Sciences, UNILAK

NYESHEJA M. Enan is Associate Professor in the Department of Computing and Information Sciences at University of Lay Adventists of Kigali, Rwanda, where he also the Dean of the faculty.

Dr. NYESHEJA M. Enan is a PhD degree holder in Satellite Imagery Analysis and Cartography obtained from the [University of Chinese Academy of Sciences \(UCAS\)](#) in China. He has a Master of Computer Applications from Vellore Institute of Technology (VIT), India and a Bachelor degree in Information Management Systems from the Adventist University of Central Africa (AUCA). He served as an Acting Head and Assistant Lecturer in the Department of Computer Engineering and Information Technology in the University of Rwanda (Former KIST) from 1999 to 2008. From 2008 to 2021, he served as the Director of ICT and Senior Lecturer. He was appointed Dean of Faculty of Computing and Information Sciences in 2021. He published and co-authored more than 45 research papers in international journals and conferences. He supervised master's programme students and worked as an external examiner for PhD students in UR and UNILAK as well as in ACEIoT (African Center of Excellence in Internet of Things) based in UR (University of Rwanda). His research interests cover Remote Sensing, Geographical Information Systems, Land use and Cover Change, Data Mining, Internet of Things and Machine Learning.

He is the Editor-in Chief Journal of Computing and Communication Innovation (JCCI) and is evaluator for international projects and PhD Thesis. Dr.NYESHEJA participated in many international conferences as Keynote Speaker.

Key Note Speaker



Michael Luther

CEO of eVerify Global

Michael Luther Expert in AI Governance, Cybersecurity, and Secure Digital Transformation Michael Luther is the CEO of eVerify Global, where he advises enterprise clients on cybersecurity, AI governance, and secure digital transformation. He is also a Partner at School Try, an EdTech platform simplifying how institutions manage, teach, and prepare learners for the future. With more than two decades of experience in enterprise technology, Mr. Luther has worked with global technology leaders including IBM, Wipro, and Fujitsu. As an international speaker and technology strategist, he contributes thought leadership on the intersection of cybersecurity, digital identity, and the responsible deployment of artificial intelligence.

Key Note Speaker



Dr. Duncan Nyale

Information-systems scholar

Dr. Duncan Nyale is an information-systems scholar, policy practitioner and consultant whose work sits at the intersection of artificial intelligence, data protection and institutional governance. He is Director of the Institute of Open, Distance & e-Learning (IODeL) and Lecturer at The Co-operative University of Kenya, where he leads strategy for e-learning, digital curriculum design and institutional quality assurance for online delivery. He holds a Ph.D. in Information Systems, an MSc (Information Systems), and a first-class BSc (Information Technology).

Dr. Nyale combines rigorous applied research with hands-on policy and systems practice. He has published peer-reviewed work on AI in higher education, digital skills alignment, and organizational resilience through trusted information-sharing, and maintains an active researcher profile and citation record across academic repositories. His recent scholarship explores how data-driven models can harmonize curriculum design with industry needs and how coordinated information-sharing improves cyber-security posture in institutions.

A seasoned policy advisor, Dr. Nyale served on the National Taskforce that developed Kenya's Data Protection (General) Regulations and has designed national and sectoral capacity-building programmes on data protection and compliance. He has led training initiatives and curriculum development for public-sector agencies and creative industries, and acted as team lead for large data-protection training engagements in partnership with national regulators and international development partners. These roles position him as a bridge between regulatory frameworks and practical organisational implementation especially around privacy, lawful processing and breach preparedness.

Key Note Speaker



Prof. Valentina E. Balas

The Faculty of Engineering, "Aurel Vlaicu" University of Arad, Romania.

Valentina E. Balas is currently Full Professor at the Faculty of Engineering, "Aurel Vlaicu" University of Arad, Romania.

She holds a Ph.D. in Applied Electronics and Telecommunications from Polytechnic University of Timisoara. Dr. Balas is author of more than 350 research papers. Her research interests are in Intelligent Systems, Fuzzy Control, Soft Computing.

She is the Editor-in Chief to IJAIP and to IJCSysE, and is evaluator expert for national, international projects.

Dr. Balas is the director of Intelligent Systems Research Centre in Aurel Vlaicu University of Arad and Director of the Department of International Relations.

She served as General Chair of SOFA conferences in nine editions organized in the interval 2005-2020 and held in Romania and Hungary.

Dr. Balas participated in many international conferences as Organizer, Honorary Chair, Session Chair, member in Steering, Advisory or International Program Committees and Keynote Speaker.

She is a member of EUSFLAT, member of SIAM and a Senior Member IEEE, member in TC Fuzzy Systems (IEEE CIS), chair of the Task Force 14 in TC Emergent Technologies (IEEE CIS), member in TC Soft Computing (IEEE SMCS).

Dr. Balas was past Vice-president (Awards) of IFSA -(2013-2015), is a Joint Secretary of the Governing Council of Forum for Interdisciplinary Mathematics, and recipient of the "Tudor Tanasescu" Prize from the Romanian Academy (2019).

ICCIST2026 ORGANIZERS

1. University of Lay Adventists of Kigali (UNILAK)



University of Lay Adventist of Kigali (UNILAK) was created by the Federation of Adventist Parents Associations for the Development of Education in Rwanda (FAPADER).

UNILAK was approved through the Convention No. 001 of 03 February 1997, which was signed between the Government of the Republic of Rwanda, and FAPADER. The Institute obtained legal identity as a nonprofit association under Rwandan law through the Ministerial Decree No. 89/11 of 02 July 2004 and it was fully accredited by the government of Rwanda through the Ministerial Order N° 002/09 of 09/04/2009. The University's Headquarters are located in the City of Kigali, Gasabo District, Remera Sector.

UNILAK has also expanded its activities in the Southern province (Nyanza) and Eastern Province (Rwamagana) and the two campuses operate with a competitive modern boarding facilities. UNILAK Data Universal Numbering System (D-U-N-S) Number is 561227536 which shows the extent to which UNILAK is credible at global level. UNILAK comprises five faculties offering both undergraduate and postgraduate programmes, namely the Faculty of Computing and Information Sciences, the Faculty of Law, the Faculty of Economic Sciences and Management, the Faculty of Environmental Studies, and the Faculty of Education. The university sustains a robust research profile through the publication of three peer-reviewed international scientific journals available both online and in print: the Journal of Computing and Communication Innovation (ISSN: 3107-2488, <https://jocci.unilak.ac.rw>), the East African Journal of Science and Technology (EAJST) (ISSN: 2227-1902, <https://ejst.unilak.ac.rw>), and the Journal of Applied Social-Economic and Business Innovation (ISSN: 3104-9257, <https://jasebi.unilak.ac.rw>). Furthermore, UNILAK organizes an annual international conference that serves as a premier platform for knowledge exchange and scholarly discourse across the disciplines of Computing and Information Sciences, Economic Sciences and Management, Environmental Studies, and Law, bringing together academic staff, students, and both national and international stakeholders. In terms of institutional affiliations, UNILAK is a member of the

Inter-University Council for East Africa (IUCEA) and the Rwandan Organization of Private Higher Learning Institutions (ORIPES), and collaborates actively with diverse public, private, and international organizations in advancing research and community development. Its principal joint research initiatives include: a collaborative study on success factors for sustainable rural development with Makerere University, Moshi University, and the Canadian Cooperative Alliance; the UNILAK-XIEG Joint Environmental and Natural Research Center; research on rice farming and sustainable rural development in Rwanda's Eastern Province; soil and water conservation studies in partnership with Xi'an University; and an examination of the role of agricultural cooperatives in sustainable rural development in collaboration with Land O'Lakes. The university's core mission is guided by the following objectives: to provide quality higher education and award undergraduate, graduate, and postgraduate degrees; to conduct and promote research across scientific and technological fields; to publish and disseminate research outputs at national and international levels; to equip students with the knowledge, skills, and technological proficiencies necessary for self-reliance and employability; to foster meaningful community engagement; and to uphold and promote Christian values as an integral dimension of its institutional identity.

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2. Rwanda Internet Community and Technology Alliance(RICTA)



The Rwanda Internet Community and Technology Alliance (RICTA) is a not-for-profit organization formed in 2005 to manage Rwanda's Internet infrastructure, specifically the .RW country-code top-level domain (ccTLD) and the Rwanda Internet Exchange Point (RINEX). It promotes local content, secures digital identities, and fosters growth in the local ICT sector.

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3. Broadband Systems Corporation



We are a technology company established in 2010, committed to delivering world-class broadband connectivity and innovative solutions that empower citizens, communities, government institutions, and businesses across Rwanda and the region. Our vision is to make Rwanda one of the most connected countries in Africa, while our mission is to provide reliable, high-quality broadband services and solutions that drive digital transformation and inclusive growth. Guided by strong values, we operate with a focus on innovation, customer satisfaction, collaboration, and excellence, ensuring that we consistently deliver meaningful impact and build lasting relationships with the communities and partners we serve.

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4. Alpha Computer Ltd



The story of Alpha Computer Ltd begins in 2004, when its founder identified a gap in the SME market for a reliable and high-quality information technology provider. There was a growing need for pragmatic, service-oriented partners willing to collaborate with businesses, support their growth, and serve as trusted ICT suppliers. Established with a vision of delivering high-quality outcomes and sustainable growth strategies, Alpha Computer Ltd is dedicated to helping clients acquire, build, maintain, and secure reliable and scalable ICT environments. Guided by core values of integrity, responsibility, competency, efficiency, and effectiveness, the company provides specialized services in audio-visual system integration, including the development of smart classrooms, smart meeting spaces, and enhanced information dissemination through digital signage and IPTV solutions. Over the years, Alpha Computer Ltd has built a strong customer base comprising satisfied partners across both public and private institutions in Rwanda. As an audio-visual system integrator, the company is the sole distributor of the Peoplelink brand in Rwanda and a preferred reseller partner of leading global brands such as Absen, Televic, Sennheiser, Fohhn, LG, and TripplePlay.

Concept Notes

International Conference on Computing, Information Sciences, and Technology
(ICCIIST 2026)

Theme: 'Harnessing Emerging Technologies for Sustainable Development:
Innovative Solutions for a Changing World'

1. Introduction

We live in an era of profound technological change. The rapid advancement of emerging technologies such as Artificial Intelligence (AI) and Machine Learning, the Internet of Things (IoT), Cybersecurity and Digital Forensics, Blockchain and Financial Technologies, Cloud and Edge Computing, Big Data and Analytics, Wireless Networks and Mobile Computing, Robotics and Automation, Sustainable and Green Computing, and Augmented Reality (AR) and Virtual Reality (VR) is fundamentally reshaping economies, societies, and development pathways across the world. These technologies are not simply tools of convenience; they are powerful forces of transformation that are redefining how nations govern, how businesses operate, how communities access services, and how individuals engage with the world around them.

In the context of sustainable development, emerging technologies offer unprecedented opportunities to address complex and interconnected challenges from economic growth and social inclusion to environmental protection and institutional efficiency. For developing countries, and particularly for Africa, leveraging these technologies is no longer optional. It is a strategic imperative for achieving resilient, inclusive, and sustainable futures that leave no one behind.

Artificial Intelligence and the Internet of Things stand at the forefront of this transformation. AI-driven systems enable intelligent decision-making, predictive analytics, automation, and optimization across critical sectors such as agriculture, healthcare, finance, education, and governance. IoT complements AI by enabling real-time data collection through interconnected sensors and devices, supporting smart infrastructure,

environmental monitoring, precision agriculture, energy management, and urban planning. Together, AI and IoT create powerful, data-driven ecosystems capable of improving service delivery, enhancing productivity, reducing resource waste, and strengthening evidence-based policymaking at all levels.

Beyond AI and IoT, technologies such as blockchain are enabling new forms of financial inclusion and transparent governance; cloud and edge computing are democratizing access to computational power; cybersecurity solutions are protecting critical digital infrastructure; and green computing is promoting environmentally responsible use of technology. Each of these innovations, when applied thoughtfully and equitably, has the potential to accelerate progress toward the United Nations Sustainable Development Goals (SDGs) particularly SDG 9 (Industry, Innovation and Infrastructure), SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), SDG 13 (Climate Action), and SDG 16 (Peace, Justice and Strong Institutions).

2. The African and Rwandan Context

In Africa, where development challenges intersect with rapid population growth, climate vulnerability, limited infrastructure, and significant skills gaps, emerging technologies present both compelling opportunities and important responsibilities. Digital solutions can support climate-smart agriculture, strengthen national cybersecurity postures, expand financial inclusion through digital finance, improve public service delivery, and foster innovation-driven entrepreneurship. However, these benefits can only be fully realized if critical issues of digital equity, ethical governance, cybersecurity resilience, data privacy, capacity building, and long-term sustainability are adequately and proactively addressed.

Rwanda, in particular, stands as a remarkable example of a developing nation deliberately harnessing technology to drive national transformation. Rwanda's National Strategy for Transformation 2 (NST2, 2024–2029) places digital transformation, innovation, and knowledge-based economic growth at the very center of the country's pathway toward sustainable development. NST2 emphasizes leveraging ICT to enhance productivity, service delivery, governance efficiency, and private-sector competitiveness. The integration of emerging technologies—AI, IoT, Blockchain, Cloud

Computing, and advanced digital infrastructure directly supports NST2's three pillars of economic transformation, social transformation, and transformational governance.

Furthermore, Rwanda's Vision 2050, which aspires to elevate the nation to upper-middle-income status by 2035 and high-income status by 2050, relies heavily on human capital development, technological advancement, and a decisive shift toward a high-value, service- and innovation-driven economy. By promoting smart infrastructure, digital entrepreneurship, and evidence-based decision-making, computing and information technologies serve as critical enablers for achieving higher productivity, deeper social inclusion, and greater environmental sustainability key milestones embedded in Rwanda's long-term national vision.

3. Conference Rationale

Against this dynamic backdrop, the International Conference on Computing, Information Sciences, and Technology (ICCIST2026), hosted by the University of Lay Adventists of Kigali (UNILAK), provides a timely, strategic, and intellectually rich platform for interdisciplinary engagement. Scheduled for March 25, 2026, and designed in a hybrid format to ensure broad participation from local, regional, and international stakeholders, ICCIST2026 is conceived as both a scholarly forum and an action-oriented convening space.

The conference brings together a diverse community of researchers, industry experts, policymakers, innovators, non-governmental organizations, and students to critically examine how computing and information technologies can be harnessed to drive sustainable digital transformation particularly within the African context. It recognizes that meaningful technological change requires more than technical solutions; it demands interdisciplinary dialogue, ethical deliberation, inclusive participation, and strong cross-sectoral partnerships.

ICCIST2026 is structured around eight core thematic tracks: **Artificial Intelligence for Sustainable Development, Internet of Things for Smart Systems, Blockchain and Cloud Computing, Wireless Networks and Digital Infrastructure, Cybersecurity and Data Privacy, Blockchain and Financial Technologies, Ethics and Digital Equity, Technology-Driven Entrepreneurship, and Sustainable and Green Computing.** Together, these tracks reflect

a holistic vision of technology that is not only advanced and innovative, but also ethically grounded, environmentally responsible, and socially inclusive.

By bringing cutting-edge research, real-world case studies, and practical solutions into dialogue, ICCIST2026 seeks to bridge the persistent gap between theory and practice, while strengthening the critical collaboration between academia, industry, and government that sustainable digital transformation demands.

4. Conference Venue

The conference will take place at Classic Hotel, Kigali on March 25, 2026, from 9:00 a.m. to 5:00 p.m.

5. ICCIST2026 Exhibition

An exhibition will be held alongside the conference where technology innovators, startups, research institutions, and companies will showcase their projects, products, and solutions. Participants will have the opportunity to explore collaborations, share knowledge, and learn from real-world implementations.

6. Conference Structure

The conference will feature:

- **Plenary Sessions:** Keynote addresses on major themes by international and regional experts.
- **Parallel Sessions:** Presentation of research papers and case studies related to emerging technologies and sustainable development.
- **Panel Discussions:** Dialogues with policymakers, technology leaders, researchers, and innovators.
- **Networking Opportunities:** Collaborative forums to foster partnerships, research initiatives, and entrepreneurial ventures.

7. Expected Contribution of ICCIST2026

By the end of ICCIST2026, participants will:

- Deep Exposure to Emerging Technologies: Expert peer feedback, new research collaborations, access to cutting-edge findings across 8 thematic tracks
- Understand strategies for leveraging digital solutions for sustainable development.
- Contribute to policy recommendations, technology adoption frameworks, and research collaborations.
- Identify opportunities for innovation-driven entrepreneurship and regional partnerships.
- Strengthen networks between academia, industry, government, and civil society to advance inclusive digital transformation.

8. Target Audience

The conference will attract a wide range of participants, including:

- Researchers and Academicians
- Technology Entrepreneurs and Innovators
- Policy Makers and Government Representatives
- Industry Experts and Practitioners
- Students and Young Professionals

9. Conference Registration

Registration fees are designed to encourage broad participation:

Categories of participants	Amount to be paid (USD)
International Participants	100
International Presenters	50
Local & East African Community (EAC) Participants	30
Local & EAC Presenters	20

Payment Account: 6775018949 / ECOBANK

Agenda of the Conference

International Conference on Computing, Information Sciences, and Technology (ICCIST 2026)

THEME: 'Emerging Technologies (IoT, AI) for Sustainable Development'

ICCIST2026 Day One: 25/3/2026

Time	Activities	
9:00 - 9:30	Arrival of Participants and Registration	
9:30 - 10:00	Opening Session Moderator: DVCAF - Prof. Jean Ngamije, Vice Chancellor, University of Lay Adventists of Kigali (UNILAK). - Dr. Kadozi Edward, Director General of HEC - Mr. David Kanamugire, Chief Executive Officer, National Cyber Security Authority (NCSA)	
10:00 - 10:30	Group photo and Health break	
10:30-11:15	Moderator: Prof. Richard Musabe Key Note Speakers - Prof. Enan Nyesheja, University of Lay Adventists of Kigali - Prof. Valentina E. Balas, Faculty of Engineering, "Aurel Vlaicu" University of Arad, Romania - Dr. G.O. Ouma Mak'Ouma, Co-founded Seventt Ltd	
11:15-12:45	Parallel session	
	Moderator: Prof. Jonathan/Dr. Irene	Moderator: Dr. Gasirabo/Dr. Sumbiri
	Data-Driven Prediction of Student Academic Performance Using Machine Learning: Exploring the Impact of Demographic, Socio-Economic, and Behavioral Factors in Higher Learning Institutions Mukashyaka Charlotte	Applying Machine Learning Algorithms to Satellite Imagery for Automated Detection and Monitoring of Deforestation Hotspots in the Congo Basin Frontier Kabatesi Gerardine, Isaac Olajide AREO, Moradeke Grace Adewumi Kalisa Theotime Muhigira, Thompson Faraday Edigbonya
	An Intelligent Curriculum Alignment Model for Bridging the Digital Skills Gap Duncan Nyale, Simon Karume, Andrew Kipkebut, Fidelis Mukudi and Abrar Sharafat	A Behavioral Analysis of Mobile User Practices and Personal Data Vulnerability: A Case of Undergraduate Students in Tanzania. Bakari Abihudi, Jaffar Msafiri Ponera and Prince Charles Lawson

	Design and Implementation of Multilingual Hand Gestures Recognition System for Dumb and Deaf. Moradeke Grace Adewumi, Tomiye Comfort Akinribido and Omolara Grace Emmanuel	Examination Hall Attendance System Using Multi-Camera LBPH Face Recognition (EHAS-LBPH) Nelson Habumugisha, Djuma Sumbiri, Enan M. Nyesheja
	Balancing Financial Technology (FinTech) Innovation and Consumer Protection in Rwanda: Policy, Practice and Pathways to Inclusive, Safe Digital Finance. Marcelline Uwiragiye and Marcus Adabokeye,	Modern Technology and Financial Inclusion: Bridging the Gap for Underserved Populations in Emerging Markets Jean Baptiste Niyitegeka
	AI-Powered Traffic Management Systems for Kigali's Urban Mobility Djuma Sumbiri, Jonathan Nturo, Patrick Habimana	Understanding and Predicting User Trust and Intention to Use Interactive AI Learning Systems Using Machine Learning Asgedom Zerue Tlahun, Emmerance Ange Mutuyemariya, Anathole Niyongana, Jean Baptiste Kayiranga, Emmanuel Cyarikunda
12:45-1:00	Moderator: Prof. Jonathan/Dr. Irene Questions and Answers Session	Moderator: Dr. Gasirabo/Dr. Sumbiri Questions and Answers Session
1:00-2:00	Lunch	
2:00-2:45	Moderator: Prof. Richard Musabe Panel Discussion: Artificial intelligence and Cyber security in modern society By RICTA, RISA, BSC and Academic Researcher	
2:45-4:00	Moderator: Dr. Irene/ Dr Moradeke Grace Adewumi	Moderator: Dr. Sumbiri/ Dr Olufisayo Taiwo Adigun
	Negotiating Authenticity in The Age of Artificial Voices: A Qualitative Interview Study of University Students Atenya Paul	Eye-Controlled Mouse System for Hands-Free Computer Access: An Assistive Technology Solution for People with Physical Disabilities Masengesho Edmond1 and Nyesheja Muhire Enan
	Smart Waste Management System Using IoT, Data Analytics, and Smart City Technologies Niyonsaba Alice , Mbarubukeye Pascal, Barigira Ahmed Djibril, Ndahindurwa Valens, Kabatesi Gerardine	The Impact of Preprocessing Techniques on the Performance of Machine Learning Models for Landslide Prediction Jean de Dieu Hagenimana, Djuma Sumbiri

	Email Domain Spoofing and CEO Fraud: A Critical Analysis of Organizational Vulnerabilities and Defense Mechanisms in the Modern Threat Landscape Jonathan Ngugi	Balancing Financial Technology (FinTech) Innovations and Consumer Protection in Rwanda: Pathways to Inclusive and Safe Digital Finance. Marcelline Uwiragiye and Marcus Adaboke
	Human-Centered AI-Driven Adaptive Interface Generation for Next-Generation Energy Systems. Jonathan Nturo, NYESHEJA M. Enan, Djuma Sumbiri	Assessing Privileged Access Risk and Compliance Gaps in Rwandan SMEs Josué IRADUKUNDA
	Cybersecurity Challenges in Emergency Communication Systems: A Rural Perspective Jonathan Oldpa Grigsby and Djuma Sumbiri	Integrating Artificial, Human and Augmented Intelligence: A Secondary Analysis of Importance and Limitations Atenya Paul
	Ensemble Machine Learning for High-Precision Classification of Invasive Ductal Carcinoma in Breast Histopathology Medical Images Habagusenga Bonaventure*, Musabe Jean Bosco, Ntivuguruzwa Jean De La Croix, Mungwarakarama Irénée	Context-Aware and Accessible Evaluation of Ai-Assisted Minimalist User Interface Design Using Performance and Perception Metrics Hanyurineza Emmanuel, Moumini Houssamoudine, Mahoro Nikuze Sandrine, Kabanyana Vanessa, Niyigena Cassian
	Improvement of Universities' Management Information Systems Using a UI/UX Paradigm: Addressing the Excessive Use of Strong Colors Uwase Phoebe, Nkurunziza James, Namahoro Janvier, Garukurebe Umusalam, Mbyayingabo Oscar, Misigaro Thomas, Sam D. Jackson, Niyogakiza Denyse, Mungwarakarama Irene, Ntivuguruzwa Jean De La Croix	Enhancing UX/UI: A Mixed-Approach Evaluation of a Web-Based Student Clearance System Ntegerejimana Fidele, Nyanzira Alice, Gitego Faycal, Mushimiyimana Jean Damascene, Iradukunda Claude
	Using UX to Enhance the Identification of the Connection Strength for Available Wi-Fi in the Current Range. Nkurunziza James, Uwase Phoebe, Namahoro Janvier, Mbyayingabo Gatele Oscar, Sam D. Jackson, Garukurebe Umusalama, Misigaro Thomas, Niyogakiza Denyse, Mungwarakarama Irene, Ntivuguruzwa Jean De La Croix.	Optimizing Crop Selection Through IoT Sensing and Machine Learning: A Random Forest Approach Using Soil and Environmental Parameters Uwihanganye Vedaste, Nyesheja Muhire Enan

4:00-4:15	Moderator: Dr. Irene/ Dr Moradeke Grace Adewumi Questions and Answers Session	Moderator: Dr. Sumbiri/ Dr Olufisayo Taiwo Adigun Questions and Answers Session
4:15-4:45	Moderator: Prof. Enan Sharing ideas on establishment of UNILAK IT Innovation Hub	
4:45-5:00	Moderator: Dr Jean de Croix/Mr. Innocent Conference Recommendations	
5:00-5:30	Closing ceremony	
5:30	Evening Tea	

Data-Driven Prediction of Student Academic Performance Using Machine Learning: Exploring the Impact of Demographic, Socio-Economic, and Behavioral Factors in Higher Learning Institutions

Mukashyaka Charlotte

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ABSTRACT

Student academic performance is shaped by a complex interplay of demographic, socio-economic, behavioral, and academic factors. Traditional evaluation methods often fail to capture these relationships, limiting the ability of educational institutions to provide timely and targeted support for at-risk students. This study presents a predictive framework employing supervised machine learning techniques including Linear Regression, Decision Trees, Random Forest, and Gradient Boosting to forecast both cumulative GPA and last-semester GPA. The analysis utilizes a dataset of 496 undergraduate students from the University of Malaya, encompassing demographic information, prior academic performance, skill proficiency, study habits, attendance, gaming behavior, employment status, and participation in extracurricular activities. Data preprocessing involved handling missing values, encoding categorical variables, and addressing class imbalance, followed by exploratory analysis to uncover patterns and correlations among features. Ensemble methods, particularly Gradient Boosting (R^2 up to 0.61, MAE as low as 0.29) and Random Forest (R^2 up to 0.60, MAE as low as 0.28), demonstrated superior predictive accuracy compared to Linear Regression and Decision Trees. Explainable AI techniques revealed that attendance and preparation hours are the most influential factors affecting both cumulative and last-semester GPA. The proposed framework provides interpretable, data-driven insights to inform educators and policymakers in designing effective interventions and enhancing academic outcomes. By integrating machine learning with educational data mining, this research supports evidence-based strategies that enable higher learning institutions to proactively optimize student performance.

Keywords: fStudent Academic Performance, Machine Learning, Gradient Boosting, Random Forest, Predictive Modeling, Educational Data Mining, Explainable AI, Attendance, Study Hours

Design and Implementation of Multilingual Hand Gestures Recognition System for Dumb and Deaf.

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ABSTRACT

Financial technology (FinTech) has become a major driver of transformation in Rwanda's financial sector, expanding access and efficiency while supporting broader inclusion goals. The government has actively promoted digital finance through targeted policies, updated regulations, and institutional support. Yet, the speed of FinTech adoption has also exposed consumers to new risks such as fraud, data privacy violations, consumer exploitation, and limited avenues for complaints. This paper examines how Rwanda balances the twin objectives of fostering FinTech innovations and safeguarding consumers. Using a documentary research design, the study provides a detailed exploration of the Rwandan FinTech ecosystem, examining how innovation is balanced with consumer protection within the country's regulatory and market context. The study also uses document analysis of national strategies and legal texts, alongside quantitative data from the National Bank of Rwanda and financial inclusion surveys. Findings indicate that Rwanda's regulatory sandbox, tiered licensing reforms, and National FinTech Strategy (2024–2029) have created an enabling environment for innovation, accelerating market entry and experimentation. As of 2023, mobile money penetration exceeded 70%, with 12 FinTech firms participating in the National Bank of Rwanda's (NBR) regulatory sandbox. These innovations have reduced product development time by nearly 40%, enhancing competition and expanding digital financial services. However, reported mobile money fraud cases increased by 15% between 2020 and 2023, and only about 35% of users demonstrate adequate understanding of digital financial products. These results highlight persistent challenges related to low financial literacy, weak enforcement of data protection, and underdeveloped redress mechanisms, underscoring the delicate balance between innovation and consumer protection. The

paper concludes that achieving a sustainable balance between innovation and protection requires continuous regulatory adaptation, collaborative governance, and proactive integration of consumer protection into FinTech design.

Keywords: FinTech, financial inclusion, innovation, consumer protection, regulatory sandbox, and digital finance.

Modern Technology and Financial Inclusion: Bridging the Gap for Underserved Populations in Emerging Markets

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ABSTRACT

Rwanda has emerged as a regional leader in digital financial inclusion, with ambitious policy goals to become a cashless economy through its "Smart Rwanda" initiative and National Financial Inclusion Strategy. This study examines how modern technologies particularly mobile money, agent banking, and digital credit are transforming financial access for underserved populations across Rwanda. With approximately 27% of Rwandan adults still lacking access to formal financial services, understanding the mechanisms, enablers, and barriers to technology-driven inclusion remains critical for achieving the country's Vision 2050 objectives. The study employed a comprehensive mixed-methods research design focusing on Rwanda's financial inclusion landscape from 2020 to 2024. It analysed 28 FinTech initiatives operating across all five provinces, including MTN Mobile Money, Airtel Money, Bank of Kigali's BK Agent banking, Equity Bank's mobile services, and digital credit platforms such as Inkunga and Mitsesho. Primary data were collected through surveys with 432 Rwandans stratified by province, gender, and rural-urban residence. In addition, 18 in-depth interviews were conducted with FinTech providers, National Bank of Rwanda officials, SACCO leaders, and district-level administrators. Six focus group discussions with 72 participants examined the experiences of women farmers, youth entrepreneurs, informal sector workers, and VUP beneficiaries. Secondary data sources included NBR financial inclusion reports, mobile network operator statistics, Irembo e-government platform data, and SACCO performance records. Results show remarkable progress in digital financial inclusion. Mobile money adoption reached 81.3%, exceeding the sub-Saharan African average of 68.5%. Digital

credit platforms served 24.7% of respondents, while agent banking reached 52.8%, with higher rural penetration (58.4%). Key enablers include government payment digitization through VUP and agricultural subsidies, SACCO integration with mobile money platforms, widespread use of the Irembo portal, Kinyarwanda language interfaces, and high public trust in Rwanda's digital systems. However, challenges persist. A gender gap of 10.9 percentage points in mobile money increases for digital credit (11.4) and mobile banking (11.5). Women face barriers such as lower national ID possession, cultural norms controlling technology decisions, limited privacy with male agents, and concerns about financial autonomy. Urban–rural disparities remain significant, with Kigali residents showing 20.8 percentage points higher adoption. Education strongly predicts usage: 92.8% among tertiary-educated individuals compared to 52.7% without formal education. Provincial differences and limited digital credit access among farmers (14.7%) further highlight persistent inequalities.

Keywords: Financial inclusion Rwanda, mobile money Rwanda, digital financial services, MTN Mobile Money, agent banking, financial technology Rwanda, cashless economy, VUP programme, SACCO digital integration, rural financial inclusion

An Intelligent Curriculum Alignment Model for Bridging the Digital Skills Gap

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ABSTRACT

The rapid evolution of digital technologies has created significant misalignment between academic curricula and labor market demands for digital skills. This study presents the development and validation of an intelligent curriculum alignment model that systematically analyzes university curricula, identifies digital competencies, and maps them to labor market requirements. The research employed a hybrid artificial intelligence approach combining web scraping, Natural Language Processing (NLP), and Decision Tree machine learning algorithms to create a comprehensive solution. The model achieved an accuracy of 88% in classifying digital skills relevance, demonstrating strong performance with high precision (0.99) for low-frequency skills and exceptional recall (0.99) for high-frequency skills. The study utilized data from 46,514 job postings across 27 occupations, resulting in a skillset database of 9,077 unique digital skills categorized by market demand. The intelligent model generates three key outputs: a Curriculum Analysis Report, a Digital Skills Index (DSI) scoring curriculum alignment on a 0-100 scale, and a Prescriptive Analytics Report providing data-driven recommendations for curriculum improvement. This research addresses critical gaps in educational responsiveness to technological change and provides a scalable framework for continuous curriculum optimization in the digital era.

Keywords: Digital skills, curriculum alignment, artificial intelligence, natural language processing, higher education, workforce development, educational technology, machine learning

A Behavioral Analysis of Mobile User Practices and Personal Data Vulnerability: A Case of Undergraduate Students in Tanzania.

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ABSTRACT

The growing use of digital technology in higher education has increased worries about the privacy and security of personal data. This study investigated how aware Tanzanian university students were of data privacy, what their online habits were, and how these factors related to their risk of having personal data theft. The study was premised on the positivism paradigm and adopted a mixed method. A cross-sectional survey design was used to underpin the study. Both probability and non-probability sampling techniques were used to select research respondents and interview participants. A total of 355 respondents participated in the study. The results uncovered a significant gap between knowledge and action. Most students understood important safety practices, like creating strong passwords, recognizing phishing scams, and avoiding unsafe websites. However, their behavior often did not reflect this knowledge; many admitted to reusing passwords, neglecting software updates, and downloading from untrustworthy sources. Statistical analysis showed a clear connection between these unsafe habits and a higher likelihood of data breaches. Additionally, the study found that university-led awareness programs were insufficient, with most students receiving little formal training on data protection. These findings suggest a two-part solution is needed. Students must work to align their online actions with their security knowledge. At the same time, universities must enhance their efforts by strengthening awareness campaigns, incorporating data privacy into the curriculum, and offering continuous digital literacy training. The study concludes that lasting data security depends not just on awareness, but on changing behavior, which requires consistent institutional support.

Keywords: Mobile users, Data Protection, Data Vulnerability, Undergraduate Students, Tanzania

Email Domain Spoofing and CEO Fraud: A Critical Analysis of Organizational Vulnerabilities and Defense Mechanisms in the Modern Threat Landscape

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ABSTRACT

Email remains the primary communication channel in modern organizations, yet this ubiquity has transformed it into the most exploited attack vector in contemporary cybersecurity. Email domain spoofing the practice of forging sender addresses to impersonate legitimate organizational members has evolved into a multi-billion dollar criminal enterprise. The FBI's Internet Crime Complaint Center reports that Business Email Compromise (BEC) attacks resulted in adjusted losses exceeding \$2.7 billion in 2022 alone, representing a 47% increase from the previous year. This research employs a multi-methodological approach combining quantitative analysis of 5,000 organizations, controlled experiments with 50 participating organizations, and analysis of 347 confirmed BEC incidents. Our findings reveal that 32% of Fortune 500 companies lack complete DMARC implementation, while 23% have enforcement policies at "none," rendering them functionally unprotected. Controlled spoofing tests showed baseline click-through rates of 34% among untrained employees, decreasing to only 22% after standard training. Organizations implementing integrated defenses combining proper email authentication (SPF, DKIM, DMARC), advanced filtering, and continuous security awareness training achieved 99.7% attack prevention rates with positive ROI within 8.3 months. We propose the "Socio-Technical Vulnerability Framework" (STVF) demonstrating that successful attacks exploit interaction effects between technical vulnerabilities and human factors, requiring layered defense strategies that address both dimensions simultaneously.

Key words: Email domain spoofing, CEO fraud, business email compromise, phishing, DMARC, SPF, DKIM, social engineering, security awareness training, cybersecurity, organizational security.

Smart Content Creation for Personalized Learning Environments Using AI

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ABSTRACT

Personalized learning has emerged as a critical approach to address diverse learner needs in modern education systems. However, creating customized learning content at scale remains challenging for educators. This paper presents an AI-powered system that automatically generates personalized learning exercises from lecture materials to enhance student engagement and learning outcomes. The system employs a fine-tuned T5 transformer model trained on the Stanford Question Answering Dataset (SQuAD) to generate two types of exercises: fill-in-the-blank questions and structured questions. For fill-in-the-blank generation, we utilize automatic keyphrase extraction algorithms to identify key concepts from lecture notes, while structured questions are generated through a text summarization and question generation pipeline. The system provides automated assessment for fill-in-the-blank exercises and facilitates instructor review for structured responses. We evaluated the question generation component using ROUGE metrics, achieving a precision of 60%, recall of 54.5%, and F1-score of 57.14%. The proposed system offers a scalable solution for reducing instructor workload while providing learners with customized practice materials derived directly from their course content. Future work will focus on incorporating adaptive learning pathways based on individual learner performance and conducting comprehensive user studies to evaluate learning effectiveness.

Keywords: Personalized Learning, Automatic Question Generation, T5 Transformer, Natural Language Processing, E-learning, ROUGE Metrics, SQuAD Dataset

Negotiating Authenticity in The Age of Artificial Voices: A Qualitative Interview Study of University Students

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ABSTRACT

The rapid advancement of artificial intelligence (AI) audio technologies, including text-to-speech systems and voice synthesis, has significantly transformed contemporary media production, communication, and learning environments. While technical capabilities of AI-generated audio have been widely documented, less attention has been given to how university students perceive, interpret, and relate to these synthetic voices. This proposed qualitative study aims to explore students' perceptions of AI-generated audio at the University of Lay Adventists of Kigali (UNILAK), focusing on three key areas: (1) students' ability to differentiate AI-generated audio from human voices, (2) their emotional, social, and aesthetic responses to AI audio, and (3) their overall acceptance and concerns regarding its use in academic and media contexts. The study will employ semi-structured interviews with undergraduate and postgraduate students drawn from media-related and non-media disciplines to capture diverse perspectives. Data will be analyzed thematically to identify patterns in awareness, trust, perceived authenticity, and ethical considerations surrounding AI-generated audio. By grounding the investigation in students' lived experiences, the study seeks to contribute empirical insight into human–AI auditory interaction within a higher education setting in East Africa. The findings are expected to inform pedagogical strategies, media literacy initiatives, and policy discussions on responsible AI audio use in universities and creative industries.

Keywords: Agriculture, Cooperative, Inclusion, Member Participation, Performance

Integrating Artificial, Human and Augmented Intelligence: A Secondary Analysis of Importance and Limitations

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ABSTRACT

This paper will examine the integration of Artificial Intelligence (AI), Human Intelligence (HI), and Augmented Intelligence (Aul) as an emerging framework for collaborative decision-making and knowledge production. As AI systems increasingly permeate domains such as education, media production, healthcare, and creative industries, understanding how human cognitive capacities interact with and are enhanced by intelligent systems will be essential. Rather than framing AI as a replacement for human intelligence, this paper will position augmented intelligence as a complementary model that foregrounds human agency, contextual reasoning, and ethical responsibility. The study will be based on secondary data analysis, drawing on recent peer-reviewed journal articles, policy documents, and interdisciplinary scholarly reports. Through a critical review and synthesis of existing literature, the paper will analyze the importance of integrating AI with human intelligence, particularly in improving efficiency, accuracy, creativity, and decision-making processes. At the same time, it will critically examine the limitations and challenges associated with this integration, including algorithmic bias, over-reliance on automated systems, issues of transparency and explainability, ethical accountability, and the potential marginalization of human judgment. By consolidating contemporary scholarship, this paper will contribute to ongoing academic debates on responsible and human-centered AI adoption. It will argue that effective augmented intelligence systems must be designed as socio-technical arrangements that prioritize human oversight, ethical governance, and critical thinking. The findings of this study are expected to inform future research, institutional policy development, and pedagogical strategies aimed at balancing technological innovation with human values.

Keywords: *Artificial Intelligence; Human Intelligence; Augmented Intelligence; Human-AI Collaboration; Ethical AI*

Applying Machine Learning Algorithms to Satellite Imagery for Automated Detection and Monitoring of Deforestation Hotspots in the Congo Basin Frontier

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ABSTRACT

This review synthesizes recent advances in applying machine learning (ML) algorithms to satellite imagery for automated detection and monitoring of deforestation hotspots in the Congo Basin. The region's vast and remote forests face increasing pressure from smallholder agriculture, selective logging, and expanding road networks, rendering conventional monitoring approaches inadequate. Drawing on 27 peer-reviewed studies published between 2018 and 2025, the review shows that ML techniques, particularly deep learning models such as convolutional and recurrent neural networks, significantly enhance the accuracy, scalability, and timeliness of deforestation detection. Applied to optical imagery from Sentinel-2 and Landsat and synthetic aperture radar data from Sentinel-1, these approaches enable near real-time identification of both abrupt forest loss and subtle degradation. Multi-sensor data integration is especially effective in mitigating cloud cover limitations and improving attribution of direct deforestation drivers, allowing clearer differentiation among agricultural expansion, logging, and infrastructure development. Case studies across the Congo Basin demonstrate successful applications in road mapping, logging intensity assessment, and detection of small-scale agricultural clearings. Despite ongoing challenges related to data scarcity, label quality, and computational demands, the literature highlights the strong potential of ML-driven satellite monitoring to support scalable, evidence-based forest governance, REDD+ implementation, and carbon accounting initiatives.

Keywords: deforestation monitoring, machine learning, Congo Basin, satellite imagery, remote sensing

Examination Hall Attendance System Using Multi-Camera LBPH Face Recognition (EHAS-LBPH)

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ABSTRACT

This study presents the development and evaluation of a Multi-Camera Automated Attendance System employing Local Binary Patterns Histograms (LBPH) for face recognition. Traditional single-camera solutions struggle in large examination halls with occlusion, lighting variability, and limited viewpoints. All these challenges are addressed in this study. This system integrates three IP cameras with LBPH and Haar Cascade Classifier algorithms to achieve real-time, accurate candidate identification. It provides daily reporting and stores attendance in Comma Separated Value (CSV) format for quick conversion to Excel or PDF.

Keywords: *Face detection, Feature Extraction, Face Recognition, LBPH, Haar Cascade algorithms, Python, OpenCV, IP Camera.*

AI-Powered Traffic Management Systems for Kigali's Urban Mobility

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ABSTRACT

Kigali's rapid growth has intensified congestion and degraded air quality along major corridors. This study designed and validated an AI-powered traffic management framework that fused multi-source real-time data CCTV/YOLO counts, IoT detectors, GPS travel times, and near-road air-quality sensors to optimize signal control in line with the City Development Strategy (CDS) smart-mobility goals. A Long Short-Term Memory (LSTM) model generated reliable short-term flow forecasts ($R^2 = 0.91$; RMSE = 8.6 vehicles/interval), which fed a Deep Q-Network (DQN) controller to adapt phase splits, cycles, and offsets across complex junctions. Over a six-month evaluation on priority corridors (e.g., CBD–Remera, Nyabugogo–Kacyiru), the AI system reduced average control delay by ~29%, increased intersection throughput by ~36%, and lowered corridor travel time by ~30%. Environmental co-benefits were observed, with fuel use declining by ~26% and near-road CO₂ and PM_{2.5} concentrations decreasing by ~25–30% during peak periods. These gains persisted across rainy conditions and demand variability and were confirmed by paired statistical tests and robustness checks. The results demonstrate deployment-ready potential: corridor-level coordination, incident-aware operating playbooks, and deep bus-priority integration (including headway stabilization) can be operationalized within the city's control center. We outline a phased scale-up path to network coordination and propose aligning the controller with electric-bus expansion and charging strategies to maximize mobility and air-quality benefits. While coverage and sensor limitations remain, the evidence indicates that data-driven, adaptive control can materially advance Kigali's goals for a smart, green, and resilient urban transport system.

Keywords: AI-powered traffic management; LSTM; Deep Q-Network (DQN); reinforcement learning; smart mobility; urban congestion; real-time IoT/CCTV data; PM_{2.5} and CO₂ emissions; transit signal priority (TSP); electric buses (e-bus); SUMO simulation; environmental sustainability; City Development Strategy (CDS) 2024–2029; Kigali.

The Impact of Preprocessing Techniques on the Performance of Machine Learning Models for Landslide Prediction

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ABSTRACT

Landslide prediction using machine learning (ML) is critical for risk mitigation, yet model performance is highly contingent on data quality and preprocessing. While numerous studies compare ML algorithms, the systematic evaluation of preprocessing techniques in geospatial landslide modeling remains underexplored, particularly in data-scarce regions. This study investigates the impact of key preprocessing techniques—specifically normalization, feature selection, and handling class imbalance—on the performance of six ML models for landslide prediction in the Ngororero Sector, Rwanda. We utilized a multi-temporal dataset (2015, 2019, 2023) comprising topographic, meteorological, and environmental factors. Six ML models (Decision Tree (DT), Neural Network (NN), Support Vector Machine (SVM), k-Nearest Neighbors (k-NN), Random Forest (RF), and Gradient Boosting Machine (GBM)) were trained and tested under different preprocessing scenarios. Techniques included Min-Max and Standard Scaling for normalization, domain-driven feature selection, and the Synthetic Minority Oversampling Technique (SMOTE) for class imbalance. Preprocessing was found to be a decisive factor in model efficacy. Normalization dramatically improved the performance of scale-sensitive models like SVM and NN, with SVM's R^2 score increasing from 0.73 to 0.91 in the 2015 dataset after Min-Max scaling. Feature selection, which identified NDVI (24.0%), Slope (23.7%), and Elevation (21.3%) as top predictors, enhanced the accuracy of k-NN and RF by up to 5%. SMOTE significantly boosted recall for minority landslide classes, ensuring more reliable hazard detection. The findings underscore that optimal ML performance for landslide prediction is not solely algorithm-dependent but is profoundly influenced by appropriate preprocessing. We recommend a preprocessing pipeline incorporating normalization tailored to the algorithm, expert-guided feature selection, and SMOTE as a best practice for developing robust landslide prediction systems, especially in resource-constrained environments.

Key Words: Landslide Susceptibility, Machine Learning, Data Preprocessing, Normalization, SMOTE, Feature Selection, Rwanda.

Smart Waste Management System Using IoT, Data Analytics, and Smart City Technologies

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ABSTRACT

Rapid urbanization and population growth have led to a continuous increase in municipal solid waste generation, creating serious challenges in collection, transportation, and disposal. Traditional waste management systems rely on fixed schedules and manual monitoring, which often result in inefficient resource utilization, overflowing bins, environmental pollution, and increased operational costs. This paper presents a comprehensive Smart Waste Management System (SWMS) that leverages Internet of Things (IoT) technologies, wireless communication, data analytics, and smart city concepts to improve the efficiency, sustainability, and reliability of waste management operations. The proposed system integrates smart bins equipped with sensors, real-time data transmission, centralized data management, and decision-support tools for route optimization and performance monitoring. The study discusses system architecture, methodology, implementation considerations, and potential benefits. The findings indicate that smart waste management solutions can significantly reduce operational costs, enhance environmental protection, and improve urban cleanliness, making them suitable for modern smart city initiatives. The proposed system integrates smart bins equipped with sensors, real-time data transmission, centralized data management, and decision-support tools for route optimization and performance monitoring. Experimental results from the system prototype show that the solution can reduce waste collection costs by up to 30%, decrease fuel consumption by approximately 25%, and lower collection frequency for half-filled bins by nearly 40%. In addition, real-time monitoring helps prevent bin overflow, improving cleanliness levels in monitored areas by an estimated 35%.

Key Words: Smart Waste Management, Internet of Things (IoT), Smart City, Sensors, Data Analytics, Route Optimization

Understanding and Predicting User Trust and Intention to Use Interactive AI Learning Systems Using Machine Learning

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ABSTRACT

Trust is a foundational factor influencing users' willingness to adopt and continue using AI based interactive learning systems, as it shapes how learners evaluate system reliability, intelligence and social presence. However, accurately predicting and understanding user trust and usage intention remains difficult because trust is multifaceted, dynamic and simultaneously shaped by system performance metrics, cognitive perceptions and behavioral experiences. Existing studies depend heavily on self-reported survey data and traditional linear statistical analyses, which limits their ability to model nonlinear relationships, incorporate behavioral performance indicators and generate reliable predictive insights for real world AI learning environments. To address these gaps, this study applies a machine learning based analytical methodology using a dataset of 320 user interactions modeling trust and intention to use through both regression and classification techniques to integrate perceptual factors, system performance indicators and user experience variables into a unified, predictive framework that overcomes limitations of prior linear, self-report only approaches. The proposed model explains 65.4% of the variance in trust ($R^2 = 0.6539$) and achieves 84.38% accuracy in binary trust classification, substantially outperforming traditional linear only baselines, while confirming social presence, perceived intelligence, explain ability, user experience, task success rate and error rate as the most influential predictors, demonstrating notable improvements over existing related studies.

Keywords: Intention to Use, AI Trust, Machine Learning, User Perception, User Adoption, Regression Analysis, Classification Models and Model Performance, Evaluation Metrics.

Eye-Controlled Mouse System for Hands-Free Computer Access: An Assistive Technology Solution for People with Physical Disabilities

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ABSTRACT

Conventional computer input devices such as keyboards and mice require precise hand and arm movements, creating significant barriers for individuals with upper-limb disabilities. This paper presents the design and implementation of a real-time Eye-Controlled Mouse System that enables hands-free computer interaction through eye movement tracking and blink detection. The proposed system leverages the Media Pipe Face Mesh framework for facial landmark detection, OpenCV for image processing, and PyAutoGUI for cursor control all operating through a standard webcam without requiring specialized hardware. Gaze direction is mapped to cursor movement across the screen, while intentional blinks are classified as left-click, right-click, and drag-and-drop commands based on blink duration. Smoothing and filtering techniques were applied to reduce cursor jitter caused by involuntary eye movements and improve overall cursor stability. The system was evaluated with more than ten participants under varying lighting conditions. Results demonstrate that users were able to successfully perform common mouse operations including cursor navigation, item selection, and drag-and-drop with acceptable accuracy and responsiveness. While performance was slightly affected under very low illumination, the system maintained reliable eye detection under moderate lighting variations. The proposed solution offers a low-cost, accessible assistive technology for individuals with motor impairments, contributing to more inclusive Human-Computer Interaction. Future work will focus on enhancing gaze estimation accuracy, refining blink detection algorithms, and extending supported interaction features.

Keywords: Eye-Controlled Mouse System, Human-Computer Interaction (HCI), Gaze Estimation, Blink Detection, Hands-free computer interaction

Optimizing Crop Selection Through IoT Sensing and Machine Learning: A Random Forest Approach Using Soil and Environmental Parameters

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ABSTRACT

Agriculture remains a cornerstone of food security, yet smallholder farmers in Rwanda continue to face significant challenges in selecting the most suitable crops for their land due to limited knowledge of soil properties and environmental conditions. This study presents the design and implementation of an IoT-enabled, machine-learning-based Crop Selection System that integrates real-time soil and environmental sensing with a predictive model to guide farmers in making informed crop cultivation decisions. IoT sensors were deployed in Gicumbi District, Northern Province of Rwanda, to collect seven key agronomic parameters namely: nitrogen (N), phosphorous (P), potassium (K), soil pH, temperature, humidity, and rainfall which were transmitted to a cloud-based MySQL database via a microcontroller for storage and processing. Four machine learning algorithms were evaluated: K-Nearest Neighbors (90%), Support Vector Machine (87%), Decision Tree (95%), and Random Forest (96%). Random Forest was selected as the optimal model due to its superior accuracy, achieving 97% precision across all classes. The trained model assessed soil compatibility for multiple crops and ranked them according to their growing probability. Field validation using seven days of real-time sensor data from Gicumbi District produced the following crop rankings: potatoes (56%), beans (43%), carrots (33%), tomatoes (33%), and rice (17%). The system was deployed as a web application, enabling end-users to upload sensor data and receive ranked crop recommendations in real time. The proposed solution demonstrates that combining IoT-based soil monitoring with machine learning can significantly enhance precision agriculture, reduce unnecessary fertilizer costs, support nutrient deficiency assessment, and improve the overall agricultural productivity of smallholder farmers in Rwanda. Future work will focus on incorporating rainfall sensing, automated irrigation, and harvest yield prediction.

Keywords: IoT, Machine Learning, Random Forest, Soil Assessment, Crop Selection, Precision Agriculture, Smart Farming

Aligning Transformer-Based UI Generation with Human-Centric Accessibility: A Multi-Objective Optimization Approach

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ABSTRACT

Automated user interface (UI) generation using Transformer-based models has shown significant promise, yet these systems often inherit and reproduce accessibility deficiencies embedded in their training data. This work addresses this limitation by introducing an accessibility-aware alignment framework that enables generative models to produce WCAG 2.2-compliant interfaces by design rather than through post-generation repair. The proposed approach integrates Group-Relative Policy Optimization (GRPO) with a severity-weighted multi-objective reward function that explicitly penalizes accessibility violations during the generation process while preserving visual coherence and semantic correctness. The framework is evaluated against a standard Transformer baseline using the UIReq-6.8K dataset and the RealUIReq-300 benchmark. Experimental results show a 60.5% reduction in Inaccessibility Rate (IR) compared to the baseline, with no degradation in visual quality or functional intent. Notably, the aligned model achieves an average aesthetic score of 4.4/5.0, demonstrating that accessibility constraints can be jointly optimized with design aesthetics and usability. These findings validate reinforcement learning-based alignment as an effective mechanism for embedding inherent accessibility into automated UI generation. The proposed method offers a scalable pathway for integrating human-centric accessibility principles into the broader software development lifecycle, advancing the reliability and inclusiveness of AI-driven interface design.

Key words: Accessible User Interface Generation, Transformer Models, Web Content Accessibility Guidelines (WCAG 2.2), Reinforcement Learning Alignment, Multi-Objective Optimization, Human-Centered Computing,

Context-Aware and Accessible Evaluation of Ai-Assisted Minimalist User Interface Design Using Performance and Perception Metrics

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ABSTRACT

Artificial Intelligence (AI) has transformed user interface (UI) and user experience (UX) design by enabling rapid prototyping and automated layout generation. While AI-assisted tools improve development efficiency, concerns remain regarding their ability to produce interfaces that genuinely enhance usability and reduce cognitive effort. Minimalist design has been widely adopted to address interface complexity; however, the lack of standardized, practical, and reproducible evaluation methods limits the reliability of existing usability assessments, particularly for AI-generated interfaces. This paper proposes an integrated evaluation framework that combines subjective user perception and objective performance measures. Mean Opinion Score (MOS) is employed to capture users' immediate impressions, while task completion time is used as a direct indicator of interaction efficiency and cognitive load. To further enhance evaluation accuracy, two complementary metrics, Weighted Edge Density (WED) and the Accessible Minimalism Index (AMI) are introduced to incorporate functional importance and accessibility considerations. A mixed-methods user study involving 150 participants from Western, Asian, and African regions was conducted across five application domains. Results show that AI-refined minimalist interfaces significantly improve usability, task efficiency, and accessibility compared to cluttered designs. The findings demonstrate that combining perception-based and performance-based metrics provides a robust and reproducible approach for evaluating AI-assisted minimalist UI designs.

Key words: Artificial Intelligence, User Interface Design, Minimalist Design, Usability Evaluation, Mean Opinion Score, Task Completion Time, Accessibility, Visual Complexity.

Enhancing UX/UI: A Mixed-Approach Evaluation of a Web-Based Student Clearance System

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ABSTRACT

Web-based student clearance systems are widely adopted to improve administrative efficiency in higher education; however, their effectiveness largely depends on usability and user experience (UX) quality. This study evaluates the UX/UI of a web-based student clearance system using a mixed-method approach that integrates webcam-based eye tracking, screen recording, interaction logging, and standardized usability questionnaires. The evaluation involved 25 participants, including students and administrative staff, who performed real clearance-related tasks on desktop and mobile devices. Quantitative results show 100% task success rates for login and logout, while success rates for document upload and review tasks reached 88% for students and 82% for staff. Average task completion times ranged from 10–14 seconds for login, 38–62 seconds for upload and review, and 4–6 seconds for logout, with desktop usage outperforming mobile usage. Eye-tracking analysis revealed shorter fixation durations for students (1.2–1.8 s) compared to staff (up to 2.6 s), indicating higher cognitive load during administrative tasks. User experience assessment using UMUX yielded higher scores for students (78 desktops, 70 mobile) than staff (72 desktops, 63 mobile). The results demonstrate that combining objective behavioral data with subjective usability measures provides a more comprehensive and reliable UX/UI evaluation framework for academic administrative systems.

Key words: Student clearance system; Usability evaluation; User experience; Eye tracking; Human–Computer Interaction.

Balancing Financial Technology (FinTech) Innovations and Consumer Protection in Rwanda: Pathways to Inclusive and Safe Digital Finance.

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ABSTRACT

Financial technology (FinTech) has become a major driver of transformation in Rwanda's financial sector, expanding access and efficiency while supporting broader inclusion goals. The government has actively promoted digital finance through targeted policies, updated regulations, and institutional support. Yet, the speed of FinTech adoption has also exposed consumers to new risks such as fraud, data privacy violations, consumer exploitation, and limited avenues for complaints. This paper examines how Rwanda balances the twin objectives of fostering FinTech innovations and safeguarding consumers. Using a **documentary research design**, the study provides a detailed exploration of the Rwandan FinTech ecosystem, examining how innovation is balanced with consumer protection within the country's regulatory and market context. The study also uses document analysis of national strategies and legal texts, alongside quantitative data from the National Bank of Rwanda and financial inclusion surveys. Findings indicate that Rwanda has made significant progress in financial technology adoption, achieving about **96% overall financial inclusion**, largely driven by digital financial services. As of 2024, nearly **86% of adults use mobile money**, **77% own registered mobile wallets**, and around **73% actively conduct digital financial transactions**, contributing to an estimated **85.3% digital financial inclusion rate**. This growth is supported by an expanding fintech ecosystem with over 75 active firms mainly focused on digital payments and related services. Although fintech adoption is growing rapidly in Rwanda, customer uptake remains constrained by several challenges. Studies show that **up to 44% of digital financial service users have encountered attempted fraud or financial loss**, weakening trust in digital platforms. Low digital and financial literacy, limited access to smartphones and reliable internet and concerns over transaction fees further discourage consistent use, thereby slowing inclusive adoption of fintech services. These customer-centred challenges highlight the need for **better consumer protection, education, and infrastructure** to support broader and safer fintech adoption in Rwanda.

Key words: FinTech, financial inclusion, innovation, consumer protection, Digital Literacy, and digital finance, Mobile Money.

Ensemble Machine Learning for High-Precision Classification of Invasive Ductal Carcinoma in Breast Histopathology Medical Images

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ABSTRACT

Invasive Ductal Carcinoma (IDC) is the most common and aggressive subtype of breast cancer, making early and accurate diagnosis critical for improving survival outcomes. Manual histopathological analysis remains time-consuming, subjective, and prone to errors. These challenges are particularly significant in resource-constrained regions such as sub-Saharan Africa. This study proposes a high-precision stacking ensemble model for the automated classification of IDC in breast histopathology images. A total of 277,524 labeled 50×50-pixel image patches from the Kaggle IDC dataset were utilized. Preprocessing steps included image resizing, grayscale conversion, and extraction of texture, color, and statistical features. Extra Trees (ET) and Light Gradient Boosting Machine (LightGBM) were used as base classifiers and combined through soft-voting ensemble stacking. The ensemble model achieved 93% accuracy, 97.3% AUC-ROC, and 86.01% MCC, with balanced precision and recall scores (94%/92% for benign, 92%/94% for malignant). This performance exceeded that of individual classifiers such as Random Forest (92% accuracy) and previous models in related studies, including Alanazi et al.'s CNN model, which achieved 87% accuracy. These results highlight the effectiveness of stacking ensembles for IDC detection and suggest the approach as a robust, scalable solution to support histopathological diagnosis, especially in low-resource healthcare settings. Future research should focus on incorporating deep features and validating the model in clinical environments.

Key words: *Invasive Ductal Carcinoma (IDC); Histopathology images; Stacking ensemble model; Feature extraction; LightGBM; Extra trees classifier; Automated classification.*

Assessing Privileged Access Risk and Compliance Gaps in Rwandan SMEs

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ABSTRACT

While PAM represents one of the core controls to help check on internal fraud and satisfy regulatory requirements, it still has underdevelopment in Rwandan SMEs. Despite the requirements of Law No. 058/2021 relating to protection of personal data and privacy, or National Cybersecurity Strategy 2024-2029, many SMEs have relatively small budgets, few members comprising an IT staff, and immature security practices. All of these factors create a perfect scenario for having high-risk configurations such as shared administrator accounts, persistent default vendor credentials, excessive privileges, and limited session monitoring, thus enabling insiders that are technically savvy to cause and cover fraudulent transactions. This research aims to assess the privileged access risk landscape and related compliance gaps in Rwandan SMEs, while developing and validating economically feasible strategies for mitigation. In particular, the specific objectives are: (1) to quantify the extent of insecure practices; (2) benchmark these against ISO/IEC 27001:2022 controls (especially clause 5.15, Access control policy, and clause 8.2, Privileges access rights), as well as against national regulatory expectations; and (3) design and propose low-cost alternatives suitable for resource-constrained organizations. Through its application of the mixed-methods design, the study has relied on multiple sources of data, including anonymous surveys of IT and security personnel from 55 different SMEs in industries such as financial services, mobile money, insurance, software development, and manufacturing, alongside analysis of online policy documents, local regulator audit results, and university-level cybersecurity curricula to identify gaps in employee training and awareness. Quantitative factors of the study applied descriptive statistical analysis, while qualitative approaches relied on thematic coding of survey interviews and technical configuration results. Research has revealed some interesting facts: around 70% of SMEs under study use shared administrative credentials, 58% keep default vendor credentials in production environments, and internal fraud detection has displayed significant detection latency of over 90 days, resulting in considerable financial loss. However, another lightweight framework comprising open-source credentials vaulting, native centralized logging, JIT access protocols, periodic privilege recertification, and compensating controls were tested to minimize privileged access risk by estimated 65% without invoking cost-prohibitive CA investments. In conclusion, the

paper fills an information chasm in emerging markets' cybersecurity research; it offers context-specific strategies based on empirical evidence. The paper gives Rwandese SMEs a practical tool to improve accountability, tackle insider risks, and meet national digital transformation targets. It presents a model with broad applicability to similar countries. The findings offer policymakers and educators insights to improve baseline cybersecurity governance.

Key words: *Privileged Access Management (PAM), Small and Medium Enterprises (SMEs), Internal Fraud, Cybersecurity Compliance, Insider Threat, Access Control, Open-Source Security.*

Balancing Agile Delivery and Security Governance: Mitigating Insider Threats in Rwandan Tech SMEs

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ABSTRACT

In this paper, the tension between rapid technical delivery and security governance within Rwandan technology small and medium enterprises (SMEs) shall be discussed, determining the effect of such a tension on the rise of insider threats. To recognize the areas of governance where insiders are enabled to compromise thrives, quantify common risky practices, and propose a feasible and resource-sensitive model of governance. A mixed approach will be followed in the proposed study, wherein online policy and other national regulatory audit findings will be compiled and assessed, and in parallel, short-format surveys will be administered of existing IT/security personnel and management, technical interviews will be conducted with technical leaders, and existing curriculum will be assessed for local cybersecurity courses. The findings will also be triangulated against international best practices, such as ISO/IEC 27001 and NIST, and analyzed from a risk perspective. From the analysis, most SMEs have flattened roles, consequently giving far more privileges for production access for development staff. Moreover, more than 70% have no formal privileged access management, and more than 60% also do not implement segregation of duties and immutable logging. All these points towards a highly increased risk of insider threats. The curriculum review and regulator report further indicate misalignment between academic training and practical control implementation. The paper contributes to the development of a practical model of Security-Agility Governance Matrix, minimum-viable controls such as clear role definitions, scoped privilege access, remote immutable logging, low-friction approval routes such as peer review for changes in production, and curriculum augmentations. It is intended to be implementable with constrained budgets while informing practice in SME environments, academic institutions, and regulatory communities to build a resilient Rwandan digital ecosystem.

Key words: *Insider Threat Detection, Security Governance Frameworks, Small and Medium Enterprises (SMEs), Segregation of Duties, DevSecOps, Cybersecurity Compliance.*

Improvement of Universities' Management Information Systems Using a UI/UX Paradigm: Addressing the Excessive Use of Strong Colors

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ABSTRACT

The rapid digital transformation in higher education, accelerated by the COVID-19 pandemic, has increased universities' reliance on web-based management systems to support academic and administrative processes. University Management Information Systems (MIS) now serve as central platforms for managing student records, course registration, grading, financial transactions, and institutional communication. As these systems become essential tools for daily university operations, their design quality directly affects user efficiency and satisfaction. One critical issue observed in many university management systems is the excessive use of strong and highly saturated colors within the user interface. Overuse of intense colors lead to visual fatigue, reduced readability, cognitive overload, and decreased user comfort. Instead of supporting clarity and efficient navigation, such design choices may negatively affect students, faculty, and administrative staff who interact with the system for extended periods. Therefore, this research referring to the usability principles, proposes a new approach to improve the University MIS through a UI/UX. This study adopts a mixed-methods approach combining usability evaluation, heuristic analysis, and experimental validation focusing on main UI dashboard and registration page. A redesigned prototype applying UI/UX principles, balanced color schemes and improved visual hierarchy with a reduced rate of color use to 50%. The results in line with the user satisfaction, task performance, and perceived usability yield promising usability, making the proposed method an important tool for the state-of-the-art benchmarks.

Key words: UI/UX, Management Information System, usability, color saturation, cognitive load, accessibility, higher education

Using UX to Enhance the Identification of the Connection Strength for Available Wi-Fi in the Current Range

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ABSTRACT

The rapid growth of wireless communication technologies has increased dependence on Wi-Fi networks for education, business, and public services. However, many users especially those with low digital skills struggle to identify strong and stable Wi-Fi signals among multiple available networks. Weak signals often result in slow internet speeds, frequent disconnections, and poor user experience. This study explores simple and practical methods for identifying strong Wi-Fi signals using basic indicators such as signal bars, RSSI (Received Signal Strength Indicator), and dBm (decibel-Milliwatts) values. The research proposes user-friendly approaches that require minimal technical knowledge and can be applied using smartphones or laptops. The findings show that combining visual signal indicators with basic signal measurement tools improves network selection accuracy and overall connectivity performance to 30% compared to the existing random searching approach. This work concludes that digital literacy and simple signal-testing practices are essential for maximizing Wi-Fi efficiency in public and private environments.

Key words: *UI/UX, Management Information System, usability, color saturation, cognitive load, accessibility, higher education*

IoT-Enabled Smart Flood Early Warning Systems for Climate-Resilient Communities in Rwanda.

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ABSTRACT

Flooding remains one of the most significant climate-related hazards affecting Rwanda, causing loss of life, infrastructure damage, agricultural disruption, and economic losses. Increasing rainfall variability associated with climate change, rapid urbanization, watershed degradation, and Rwanda's mountainous topography contribute to heightened flood vulnerability across both rural and urban communities. National disaster management initiatives have introduced hydrological monitoring stations, automated weather sensors, and river-level detection infrastructure to improve early warning capabilities. However, limitations persist in spatial data coverage, predictive analytics integration, real-time communication reliability, and community-level accessibility of warning information. This paper proposes an Internet of Things (IoT)-enabled smart Flood Early Warning System (FEWS) designed to enhance climate resilience in Rwanda. The framework integrates distributed environmental sensors, cloud-based analytics, machine learning prediction models, geographic information systems (GIS), and community alert dissemination mechanisms. Emphasis is placed on affordability, scalability, sustainability, and accessibility across both urban and rural contexts. The study presents system architecture, sensor deployment strategies, data processing methodologies, predictive modeling approaches, implementation considerations, and comparative insights from other African flood monitoring initiatives. The proposed system aims to strengthen disaster preparedness, improve situational awareness, support evidence-based decision making, and contribute to sustainable climate adaptation strategies. The findings suggest that IoT-enabled FEWS can significantly enhance Rwanda's disaster risk reduction capacity while providing a scalable model for other climate-vulnerable regions.

Key Words: Flood Early Warning Systems, Internet of Things, Climate Resilience, Rwanda, Disaster Risk Reduction, Hydrological Monitoring, Smart Sensors, Environmental Monitoring, Machine Learning, Climate Adaptation.

Human-Centered AI-Driven Adaptive Interface Generation for Next-Generation Energy Systems.

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ABSTRACT

The ongoing transformation of global energy systems toward decentralized renewable generation, distributed storage, electric mobility infrastructure, and digital grid intelligence has introduced significant operational complexity. While digital control platforms such as Supervisory Control and Data Acquisition (SCADA) systems and energy management systems (EMS) provide monitoring and automation capabilities, their human-machine interfaces frequently remain difficult to use, cognitively demanding, and insufficiently accessible. These limitations can increase operator error rates, slow response to system disturbances, prolong training periods, and ultimately reduce system reliability and safety. This paper proposes a human-centered artificial intelligence framework for adaptive interface generation designed specifically for next-generation energy systems. The approach leverages transformer-based AI models to dynamically generate context-aware control dashboards that prioritize accessibility, usability, and operator situational awareness. Accessibility constraints aligned with WCAG 2.2 guidelines are embedded directly into the interface generation process, positioning inclusive design not merely as compliance but as an operational reliability mechanism. The proposed system integrates with existing energy infrastructure platforms including SCADA, renewable energy monitoring tools, storage management systems, and electric vehicle charging networks. Preliminary conceptual analysis suggests potential reductions in operator cognitive load, improved onboarding efficiency, enhanced decision support, and increased resilience of complex energy operations. The study contributes to emerging research at the intersection of artificial intelligence, human-centered design, accessibility engineering, and energy system digitalization, offering a novel perspective on how adaptive AI-generated interfaces can support safer, more inclusive, and more reliable energy infrastructures.

Key Words: Artificial Intelligence; Human-Centered Design; Smart Grids; Accessibility Engineering; Renewable Energy Integration; Transformer Models; Energy Management Systems

Cybersecurity Challenges in Emergency Communication Systems: A Rural Perspective

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ABSTRACT

Emergency communication systems are critical enablers of effective disaster response, supporting coordination among first responders, local authorities, and affected communities. In rural regions particularly within developing countries of Africa these systems commonly operate over temporary wireless and infrastructure-less networks such as mobile ad hoc networks (MANETs), opportunistic networks, or UAV-assisted links when conventional telecommunication infrastructure fails. Despite their flexibility and rapid deploy ability, these systems are exposed to significant cybersecurity threats that can compromise data integrity, confidentiality, and availability, ultimately undermining emergency response effectiveness. This paper investigates the cybersecurity challenges inherent to emergency communication systems within rural settings, identifying common vulnerabilities such as unauthenticated nodes, limited encryption, resource constraints, and susceptibility to denial-of-service and eavesdropping attacks. Drawing on recent studies and simulation frameworks including OMNeT++ we analyze network behaviors under attack and evaluate lightweight, context-aware protection mechanisms suitable for low-resource environments. The results highlight the urgent need for security-by-design approaches that balance resilience, resource efficiency, and scalability in rural emergency networks. Our work contributes actionable insights for policymakers, technologists, and community stakeholders striving to strengthen cyber-resilient emergency communication infrastructure in underserved and remote areas.

Key words: *Emergency Communication Systems, Cybersecurity, Rural Networks, MANETs, Disaster Response, Lightweight Security*

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