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Editors

Book of Abstracts

1ST INTERNATIONAL CONFERENCE ON TECHNOLOGICAL ADVANCEMENT IN EMBEDDED AND MOBILE SYSTEMS (ICTA-EMOS)

Arusha, Tanzania

24th – 25th November 2022

Carl von Ossietzky Universität Oldenburg

CENIT@EA
Centre of Excellence for ICT in East Africa

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Preface

This Book of Abstracts is a collection of all abstracts of papers presented at the 1st International Conference on Technological Advancement in Embedded and Mobile Systems (ICTA-EMoS) 2022. ICTA-EMoS is organized by the Nelson Mandela African Institution of Science and Technology (NM-AIST), Tanzania, and the Carl von Ossietzky University of Oldenburg, Germany, under the umbrella of the Centre of Excellence for ICT in East Africa, CENIT@EA. This first instalment of ICTA-EMoS took place at Arusha International Conference Centre (AICC) on the 24th and 25th of November 2022.

As a key academic output of the project "Digital Skills for an Innovative East African Idustry", dSkills@EA – CENIT@EA, ICTA-EMoS provides a valuable platform for researchers, industry practitioners and multipliers to discuss recent developments in embedded and mobile systems (EMoS). It establishes a hub for further advancements in the field, with an international appeal and a strong impact on the East African region.

CENIT@EA and ICTA-EMoS are funded by the German Academic Exchange Service (DAAD) with funds from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the Federal Ministry for Economic Cooperation and Development (BMZ). We thank them for their support. Our gratitude also goes to the Inter-University Council for East Africa (IUCEA) and all other partners of CENIT@EA and the sponsors of the Conference. We thank the numerous authors who submitted a paper and all reviewers.

Arusha, November 2022

Jorge Marx Gómez
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DAY ONE – 24TH NOVEMBER 2022

SESSION I – SMART SYSTEMS DEVELOPMENT

Time: 15:10 – 16:30

Mobility Transition & Quality of Life (MobiLe)– The development of a qualitative model for conveying significant interdependencies in the complex transport system

Sreedhar Kokkarachedu[1] and Jorge Marx Gómez[1]
[1]Carl von Ossietzky University of Oldenburg, Germany

Nowadays, sustainable urban development plays a key role in improving the life quality of people. This can be achieved through mobility transition. So, Municipal politicians need to take transport-related decisions toward sustainability. This research mainly aimed to provide novel decision-making aid for municipal politicians to better understand and consider the complexity and interdependencies of the municipal transport system. This enables local politicians to assess the complex effects of traffic-effective decisions independently and at an early stage. For this, a web app is developing as easy-to-use software.

Concept integration of APQC's Process Classification Framework (PCF) and Enterprise Architecture Frameworks with Signavio

Hans-Jürgen Scheruhn[1] and Pranta Nath[2]
[1]Business Informatics, Media Informatics, Hochschule Harz, Germany
[2]Technology and Innovation Management, Hochschule Harz, Germany

In this research, an integration between process frameworks and enterprise architecture frameworks was conducted. A well-recognized process framework, APQC's Process Classification Framework® (PCF) and Enterprise Architecture (EA) framework based integrated Information Architecture (IA) model called Enterprise Online Guide (EOG) were chosen. The scope of the re-search was on a typical order-to-cash end-to-end process built around a fictitious company called Global Bike Incorporated (GBI). The necessary and additional models for the integration was created using SAP Signavio Process Manager. This research and the models prove that the process hierarchy levels of EOG can be aligned with PCF and the inclusion of process metrics from PCF to EOG increases the holistic view of EOG.

Smart Solution for Optimized Mass Customization Process in Smart Phone Industry

Ankita Dixit[1], Jaideep Singh[1], Abhinav Dixit[1], Karan Guleri[1] and Harpreet Kaur[1]
[1] Independent researchers, India

The concept of mass customization envisages a firm pursuing differentiation vis-à-vis its competitors in the form of its customized solutions to the consumers, and at the same time adopting the cost-effective measures to bring down the cost of production of those solutions. Mass customization has proved to be a path-breaking approach in many industries like fashion, footwear and computer. In this paper, we aim to cover the possibilities of mass customization in smart phone industry at hardware, software as well as OS level. We will also cover how, by implementing mass customization, smart phone companies can save costs of finished goods inventories, and at the same time, increase consumers' willingness to pay by providing them customized solutions. This paper proposes smart solution for implementing mass customization through mathematical formulation, and aims to detect the optimized groups and cost estimation.

Assessment of ICT Infrastructure in Rural Areas to Support use of Websites to Disseminate Crops Production and Management Information: Case of Tanzania

Victor Ngessa[1], Kisangiri Michael[1], Kelvin Mtei[1] and Mawazo Magesa[2]
[1]Nelson Mandela African Institution of Science and Technology, Tanzania
[2]Sokoine University of Agriculture, Tanzania

The focus of this study was to assess available ICT infrastructure in rural areas in Tanzania and the willingness of smallholder farmers (smallholders or farmers) to learn crops production and management skills using websites. ICT infrastructure forms the backbone upon which ICT services can be built and offered to users - be individuals or businesses. Respondents for this study were farmers who own mobile phones selected randomly in five (5) out of seven (7) main agricultural zones of Tanzania. A total of 532 respondents were involved in the study. Questionnaire and documentary reviews were used to collect data. Findings show that majority of smallholder farmers own basic phones, followed by smartphones and feature phones. Farmers can also afford to buy internet bundles, doesn't see internet speed as a problem, charging mobile phones is not a problem either, and are willing to learn crops production and management skills using websites. Lastly, ICT policies and regulations are in place to ensure smooth use and growth of the technology in Tanzania. These findings suggest that developers and other stakeholders involved in information dissemination to smallholder farmers can design and develop websites and other applications targeting feature phones and smartphones covering whole crops production and management cycle.

Analysis of the measurements of cycle path surface quality as collected by three different technologies

Jana Klemp[1], Jorge Marx Gómez[1], Johannes Schering[1] and Steven Soetens[2]
[1]Carl von Ossietzky University of Oldenburg, Germany
[2]Province of Antwerp, Belgium

Surface quality of bike paths play an important role in the decision whether people are using the bicycle or not. As part of a test scenario with three different mobile bicycle measurement technologies the surface quality of five different road sections in the Province of Antwerp (Belgium) was measured. From these measurements each measurement technology calculated an average value all 12.5 meter. Every road section has been measured twice by each technology. Within this paper we describe the experiment and analyze the reliability of the measurements. Further we visualize the measurements in two

different ways and investigate which presentation form leads to more similar graphs. Regarding the reliability of the graphs two of the three technologies have similar courses after repeating the measurements. For the third technology similarity could be found in the distribution of the measurements. We could show that it leads to more similar graphs when the measurements are plotted depending on the stored GPS coordinates instead of plotting them in sequence one after the other.

A Brief Introduction into (De-)Coupling Lifecycles in Net-Centric Systems-of-Systems

Johann Schütz[1] and Jorge Marx Gómez[2]
[1]OFFIS, German
[2]Carl von Ossietzky University of Oldenburg, Germany

The future viability of artificially engineered systems is significantly influenced by their ability to evolve – their evolvability. Evolvability itself can be regarded as the long-term ability of an architecture to adapt to change over time. How time and cost intensive such adaptations are, however, is significantly determined by the overall architecture or design of the respective system. As (historically grown) isolated infrastructures coalesce within emerging areas / domains into collaborative Systems-of-Systems (SoS), new higher-level structures are created. If the manifold solutions of the heterogeneous CS are developed in parallel and not viewed from a holistic point of view, innovations emerge locally and uncoordinated resulting in an unmasterable complexity of the overall architecture – unwanted dependencies with a multitude of undesirable side effects for both the SoS as well as the CS are the inevitable consequence. As a result, the necessity arises to consider the resulting structures/ architecture, instead of the individual components on their own. This contribution investigates how such dependencies arise and how they can be prevented.

SESSION II – ARTIFICIAL INTELLIGENCE TOOLS AND APPLICATIONS

Time: 15:10 – 16:30

Extraction of Numerical Facts from German Texts to enrich Internal Audit Data

Gerrit Schumann[1] and Jorge Marx Gómez[1]
[1]Carl von Ossietzky University of Oldenburg, Germany

Large-scale automated data processing is usually only possible for internal auditors in the case of structured data. Unstructured data, such as facts contained in texts, on the other hand, are often processed manually and using sampling. This, in turn, can increase the risk of disregarding relevant information during an audit. To address this risk, we present an approach that can be used to extract numerical facts along with their associated entities and relations from German texts and convert them into a format that can be processed by audit tools. The algorithm developed for this purpose follows a rule-based logic and was evaluated using 4,637 sentences from 50 German annual reports. The results show that in more than 75% of all cases the entity and relation of a numeric value within the sentence could be determined correctly.

Machine and Deep Learning Applications in the Context of Pig Precision Livestock Farming: A Systematic Literature Review

Jan-Hendrik Witte[1], Johann Gerberding[1], Sven Lampe[1] and Jorge Marx Gómez[1]
[1]Carl von Ossietzky University of Oldenburg, Germany

In recent years, Machine Learning (ML) and Deep Learning (DL) have been increasingly applied in the domain of Pig Livestock Farming. However, an overview of literature in which ML/DL is used does not yet exist. This review examines (1) in which research fields ML/DL is utilized, (2) what methods and data are used and how they are evaluated (3) as well as which challenges, and limitations currently exist. The results of the systematic literature review show that the used methods lag behind the state of the art (SOTA) of general Computer Vision (CV). There are also problems with the comparability of solutions found in literature, since there are no general benchmarking datasets available to

com-pare the use case specific results. This review should serve to find new research fields in the application of ML/DL in Pig Livestock Farming and to show potential transfer possibilities of methods to this domain.

CNN With Attention Guided Concatenation for Improved Image Restoration

Gladys Mange[1], Ronald Waweru[1], Michael Kimwele[1] and Jorge Marx Gómez[2]
[1]Jomo Kenyatta University of Agriculture and Technology, Kenya
[2]Carl von Ossietzky University of Oldenburg, Germany

Deep ConNets (DCNNs) architectures have been manipulated in several ways to boost their performance. Deeper CNNs suffer from the difficulty of training and increasing the width gives rise to more parameters and increases the complexity of the denoising model. One way of promoting CNNs is the combination of image features extracted from different CNN architectures. This research seeks to develop an optimized CNN model by combining two networks to increase the width and hence improve the performance of the combined network, which is better than when the networks are used individually. Our approach uses a Self Attention Module (ATT) to fuse the outputs from the two networks. The CNN With Attention module (CWATT) performed better than the CNN with NO Attention (CNOATT) on both Peak Signal to Noise Ratio (PSNR) and Structural Similarity Index (SSIM). For noise level 75, the CWATT model performed better than the CNOATT with a difference of 4.74/0.14 for the CBSD68 dataset and 3.03/0.11 for the kodak24 dataset for PSNR/SSIM, respectively. Other researchers can implement this structure of model con-struction to promote functionality.

Evidence Based Practices on Co-Operative Societies Information Record Management

George Germinous[1] and Mussa Dida[1]
[1]Nelson Mandela African Institution of Science and Technology, Tanzania

Co-operatives have proved to be one of the driving forces in the socio-economic empow-erment of its members. The Government of Tanzania has been implementing the Poverty Reduction Strategy by encouraging people to form co-operatives in order to improve their economic prospects. Establishing a primary co-operative society involves a process which passes through district co-operative office, regional co-operative office and the registrar of co-operatives' office at the national level. These processes bring about the issue of documentation and records keeping. The processing of records is done manually

by using pen and papers, or electronically using computers, smart phones and cameras. The manual process brings the challenge of time-consuming during data processing, inconsistency and inaccuracy of data, and difficulties in reporting. On the other hand, there are difficulties in accessing data where public gain access by physically visiting the office or view a summary on the TCDC website which are not real-time data. The study uses questionnaire, interview, observation and document review to collect the data. This paper presents the evidence-based practices on co-operative societies' information record management, a case of Kilimanjaro region with a designed proposed solution.

Developing Proof of Concepts for Sustainable Smart Solutions with the Google Design Sprint and LEGO® Serious Play®

Marius Wybrands[1], Barbara Rapp[1], Andrea Klahsen[1] and Florian Grubitzsch[1]
[1]Carl von Ossietzky University of Oldenburg, Germany

New forms of agile thinking have entered the professional world. Especially at the beginning of a project, ideas must be generated, tested, and evaluated. The methods Google Design Sprint and LEGO® Serious Play® are two methods that are suitable for generating, testing, and evaluating new methods. This publication shows how the methods can be applied in different use cases in smart work and cities.

Data Requirements for the Analysis of a Company's Car Fleet

Bettina Steden[1] and Jorge Marx Gómez[1]
[1]Carl von Ossietzky University of Oldenburg, Germany

This work investigates the operational possibility of converting a conventional vehicle fleet to an electric car fleet. The work was carried out as part of the ELogZ - Energy Supply Concepts for Carbon Neutral Logistics Centers - project. Three criteria have been identified as particularly relevant: the range requirements, the utilization or availability of the vehicle fleet, and the requirements for adequate charging infrastructure. The latter is closely related to the energy demand of the fleet. The data requirements for evaluating these criteria are addressed. An evaluation of the approach is carried out using an exemplary vehicle fleet.

Time: 15:10 – 16:30

A KPI system to measure bicycle attractiveness of a city

Johannes Schering[1] and Jorge Marx Gómez[1]
[1]Carl von Ossietzky University of Oldenburg, Germany

Many municipalities want to become more bicycle friendly to convince more people to use the bike more often and to become a more attractive city. Bicycle Data is already available from many locations and use cases to support the decision-making processes. The research problem is how the different data sources and related Key Performance Indicators (KPIs) can be meaningful connected. There will be data sources that are more relevant than others. In addition, many of the calculated numbers will be depending on other indicators (e.g., number of bike connections and number of trips). Decision makers would like to know more about the attractiveness of the bicycle infrastructure. As part of this contribution, we suggest a KPI system that is inspired by the DuPont System of financial control as a solution. There are many data sources available as smartphone app data, mobile sensor data, parking and counting data, cycling path and road conditions data (e.g., surface types, length, width), citizen reporting data or (near) accident data. We suggest classifying these data sources and the related KPIs according to the categories Bicycle Use, Bicycle Infrastructure and Traffic safety. In the conclusion the further development steps will be described. The KPI system including its interconnections will be evaluated on its relevance with traffic planning experts and other stakeholders. The perspective goal is to achieve a stakeholder oriented KPI system to measure the quality of the bike path network.

Analysis of Bicycle Use in Germany Cities Based on Smartphone App-generated Data

Firdaous Hebbal[1], Johannes Schering[1], Jorge Marx Gómez[1] and Jana Klemp[1]
[1]Carl von Ossietzky University of Oldenburg, Germany

A worldwide uptake of cycling can be perceived. Even more, cycling is possible and can be assisted by digital solutions. Many cities and regions have started to gather smartphone application-based cycling data to get an overview about bicycle use on site. The question whether and how these results from different cities may be compared. Commuter mobility has a huge impact on traffic volume – there is a lot of potentials to push more people toward bicycle use. As part of the Company Bicycle Challenge that was conducted in Germany in 2021 in cooperation with about 13 companies all over the country, a nudging approach was implemented. Employees had the opportunity to win prizes for cycled kilometers. As part of this contribution, we present the preliminary results from the data analysis part. After the preprocessing steps, different cities can be compared in geographical and temporal dimensions. The distances, durations, and speed levels from differ-ent cities give an overview of where and how the smartphone app was used. Most trips were gathered in the cities of Dresden (Saxony), Recklinghausen, and Bad Oeynhausen (both in North Rhine-Westphalia).

Barriers to Using Open Data in the Innovation Process

Ifeoluwapo Fashoro[1], Antonieta Alcorta de Bronstein[2] and Jantje Halberstadt[2]
[1]Nelson Mandela University, South Africa
[2]University of Vechta, Germany

Open data is increasing in popularity worldwide with many governments, private organisations and citizens driving its adoption by releasing previously private data to the public. The most articulated benefit of open data is in-novation, as it is expected to provide opportunities to create new products and services that tackle grand societal challenges. Innovation, however, is a complex process and the use of open data in this process increases the complexity. The existing literature has identified innovation barriers and open data barriers. Nevertheless, there is little information on how these barriers influence the innovation process. This paper proposes a conceptual framework that maps out the open data and innovation barriers related to the different stages of the innovation process.

Multilevel Trustworthiness for improved Process and Network Security in Critical Infrastructures and Domains

Hermann Strack[1], Marlies Gollnick[1], Sebastian Karius[1], Robin Kopitz[1], Meiko Lips[2] and Sandro Wefel[2]

[1]Hochschule Harz, Germany

[2]Martin Luther University Halle-Wittenberg, Germany

The secure digitalization of distributed workflows with different stakeholders (and trust relationships) as well as industrial network domains with needs for higher security and trust is of increasing interest, especially multi-level combined for process and network security (ProSec/NetSec). Developments for improved ProSec/NetSec in Critical Infrastructures and Domains with embedded and mobile systems, such as security standards and infrastructures by means of eIDAS/eID & Trust Services (TS) with Smart-eID for higher security levels (LoA) are presented. New extensions of mobile privacy-protected Pro-Bio-Id for process level and Transistor network components for network security level are included.

Competencies for Southern African Computing Sciences Graduate in the Fourth Industrial Revolution

Rexwhite Tega Enakrire[1] and Brenda Scholtz[1]

[1]Department of Computing Sciences, Nelson Mandela University, Port Elizabeth, South Africa

This paper which reports on the competencies for Southern African Compu-ting Sciences in the fourth Industrial Revolution was drawn from the IS 2020 draft document that reflect the propagation of a competency model for undergraduate programmes in Information Systems. The rationale for competencies of computing sciences graduate is due to the changes, transformation and increasing tasks which employees are confronted with on daily basis in the workplace, where much of their intellectual ability are required for ser-vice delivery. Organizations now require adequate competencies from employees in order to accomplish tasks, remain relevant, compete and sustain the organizational goals which they profess. The qualitative research approach which underpins systematic literature review was adopted for this paper. The findings revealed that competencies cannot be undermined in any organization as it is the panacea to organizational productivity. Southern African computing sciences graduates should employ other ways of informal training to acquire more knowledge and skills that would improve their competencies even after graduating from the university. This would advance their position for better functionality in the organization and society. Compu-ting sciences curriculum in

higher education institutions in the Southern Africa should be review every five years to incorporate new approaches to developing and preparing students for employability purposes. Challenges of much dependence on administrators, friends/ family members and government support has made many computing sciences graduates to become reductant and not advancing their dreams. The study recommends strategic approach in the incorporation, replication and culture of self-confidence for personal development, curriculum review and rigorous teaching and learning for computing sciences graduates in the Southern Africa context.

Evaluating the Impact of Energy Pricing Policies on Households Consumption Behaviour in Light of Global Pandemics Using Theoretical System Dynamic Model

Mohamad Hamed[1] and Jorge Marx Gómez[1]

[1]Carl von Ossietzky University of Oldenburg, Germany

Adapting to the new lifestyle in terms of epidemics has become an absolute necessity. After more than two years of global suffering from the Corona pandemic, governments should take control of the new lifestyle that has emerged as a result of the pandemic, with its far-reaching consequences for societies and economies, and continue to implement environmentally strategic plans to combat global warming and transition to green energy. Increased renewable energy production, according to studies, is insufficient to reduce carbon emissions or meet global warming goals due to its characteristics in the principles of intermittency and instability of production, which differ from conventional energy, which is determined by consumer behavior and produced on demand. Energy pricing regulations are one of the variables that impact energy consumption behavior, particularly within householders, and require careful consideration in various life situations. The relationship between energy pricing regulations and household consumption patterns, on the other hand, seems to be poorly understood. Because pricing policies may have different impacts on energy-consuming behavior in normal and epidemic situations. This paper is an introductory study to adopt a system dynamics methodology for assessing the impacts of energy pricing policies on household consumption patterns in order to make consumption behavior more flexible and compatible with renewable energy production. This research proposes a theoretical system dynamic model to examine the influence of implemented energy price regulations on household consumption behavior in Germany. This model analyses householders' responses to energy pricing policies and describes the components that can influence householder consumption behavior during pandemics and crises and taking into account generating patterns in renewable energy resources, primarily solar and wind energy, which represent the majority of the renewable energy output.

Time: 15:10 – 16:30

A Machine Learning Internet of Things (IoT) –Adaptive Smart Cloud Farming System for Small-Scale Farmers in Tanzania

Alcardo Alex Barakabitze[1] and Ames Robert[1]
[1]Sokoine University of Agriculture, Tanzania

Agriculture is a high-priority sector of the Tanzania economy, with more than 80% of all Tanzanian families relying on it for their livelihoods, either directly or indirectly. Agriculture is the primary source of food, employment, and economic progress. Increasing output quality and quantity while lowering operating costs is critical in agricultural production. Farmers must overcome several problems and make efficient use of limited resources in order to ensure the agricultural sector's sustainability in Tanzania and around the world. Recent advancement of technologies such Machine Learning (ML) and Internet of Things (IoTs) has shown to assist farmers in finding solutions to various difficulties and maximizing the use of limited resources. To achieve the highest yield, agriculture needs the assistance of modern automation to boost yield/crops production. This paper presents a real-time implementation of a ML -based adaptive smart farming management system with open IoT solution over cloud computing to increase agricultural productivity of Small-Scale Farmers (SSFs) in Tanzania. The aim is to help SSFs to analyze crop related activities in order to optimize farm productivity. The ML-based IoT smart farming system using sensor nodes is developed to enable farmers to collect massive amounts of streaming data which offers new pathways for monitoring agricultural and food processes in Tanzania. The paper is part of the SUA's project implementation of (a) efficient IoT-based cloud computing farm management system using ML to monitor in real-time crop performance and provide decision support tools for SSFs, (b) novel AI/ML advanced algorithms to detect pests, diseases, and weeds using resource-constraints devices such as smartphones (c) a synthetic database using Generative Adversarial Networks (GANs) for crops, weeds and pests for generation of ML training dataset and virtual farm establishment, and (d) AI solutions that can utilize farm data to derive farm decisions that might improve crop management and provide insightful information on the past practices that led to good or bad yields. This paper provides baseline of proposing measures that will support decision-making in terms of policy and intervention strategies in the context of monitoring crops performance in the farms belonging to SSFs in Tanzania.

IoT and health systems in developing countries: A review

Doudou Dione[1], Idy Diop[1], Demba Faye[1], Ibrahima Gueye[1] and Sidi Mohamed Farssi[1]
[1]Ecole Supérieure Polytechnique

The Internet of Medical Things (IoMT) is today the foundation of healthcare systems with various applications and wireless communication technologies for information transmission. But to take advantage of this potential, secure and reliable communication with a good health bandwidth is indispensable. In addition to all these aspects, energy consumption and a good quality of service is required. The Internet of Things (IoT) in healthcare systems can be the future of intelligent, more flexible and interoperable healthcare. This article discusses and presents different concepts of Internet of Things technology, emerging communication technologies suitable for healthcare applications for monitoring, treatment and diagnosis. But also, it highlights some challenges related to the security and privacy of patient data.

Performance Comparison between Massive MIMO Based Network and Conventional LTE Network for High-Speed Broadband Connection in Rural Areas of Tanzania

Marko Mwalongo[1] and Kilavo Hassan[1]
[1]University of Dodoma, Tanzania

Broadband connection refers to the transmission of a wide bandwidth data through high-speed internet connection. People in rural areas need broadband connection for services like e-governance, virtual classrooms, telemedicine, video-on-demand, and home entertainment. This highlights that the need for high-speed broadband connection in rural areas is inevitable. However, in order to provide broadband services, service providers must incur high deployment costs and wait for a long time for return on investments. Long Term Evolution (LTE) has been pro-posed to overcome high deployment cost, although it has some coverage limitations in rural areas. Thus, massive Multiple-Input Multiple-Output (MIMO) with its favorable propagation phenom-enon can be exploited as an alternative to boost signal coverage in rural areas. Therefore, study compared the performance of broadband network for Tanzanian rural areas based on massive MIMO technology and LTE. Performance comparison of networks was confined to Reference Signal Received Power (RSRP), Signal-to-Interference-plus-Noise Ratio (SINRu) and downlink (DL) throughput metrics observed by user equipment for 5MHz, 10MHz and 20MHz channel bandwidths at 2.1GHz and 700MHz carrier frequencies. The results show that massive MIMO network at 5MHz bandwidth performs better in terms of RSRP and SINRu when compared to 10Hz and 20MHz channel bandwidths to conventional LTE net-

works. Initiative of the United Republic of Tanzania in bringing broadband services to rural areas so that at the end of 2021 and 2024 broadband population coverage in Tanzania should be 60% and 90% respectively was the motive behind study to support Tanzanian industrial economy.

A Machine Learning-Based IoT Environmental Monitoring Platform for Data Centres

Wayne Steven Okello[1], Silas Mirau[1], Michael Kisangiri[1], Andrew Katumba[2] and Edwin Mugume[2]

[1]Nelson Mandela African Institution of Science and Technology, Tanzania

[2]Makerere University, Uganda

Data centers are a crucial part of many organizations in the world today consisting of expensive assets that store and process critical business data as well as applications responsible for their daily operations. Unconducive environmental conditions can lead to decline in performance, sporadic failures and total damage of equipment in the data centers which can consequently lead to data loss as well as disruption of the continuity of business operations. This paper describes an environmental monitoring system that employs IoT and machine learning to monitor and predict important environmental parameters within a data center setting. The system comprises of a Wireless Sensor Network (WSN) of four (4) sensor nodes and a sink node. The sensor nodes measure environmental parameters of temperature, humidity, smoke, water, voltage and current. The readings captured from the sensor nodes are sent wirelessly to a database on a Raspberry Pi 4 for local storage as well as the ThingSpeak platform for cloud data logging and real-time visualization. An audio alarm is triggered, and email, Short Message Service (SMS), as well as WhatsApp alert notifications are sent to the data center administrators in case any undesirable environmental condition is detected. Time series forecasting machine learning models were developed to predict future temperature and humidity trends. The models were trained using Facebook Prophet, Auto-Regressive Integrated Moving Average (ARIMA) and Exponential Smoothing (ES) algorithms. Facebook Prophet manifested the best performance with a Mean Absolute Percentage Error (MAPE) of 5.77% and 8.98% for the temperature and humidity models respectively.

IoT-Based Control AND Monitoring System of a Solar-Powered Brushless DC Motor for Agro-Machines

Gilbert Minja[1], Jema Ndibwile[1] and Shubi Kaijage[1]
[1]Nelson Mandela African Institution of Science and Technology, Tanzania

Locally made agricultural machines have proven to elevate the life of many small-scale farmers, which has increasing need to incorporate machine drives and controls to ease operations, using the Internet of Things (IoT) basics in tandem with motor designs and available of-the-shelf single board computer and development board in Raspberry Pi and Arduino UNO respectively. This work incorporated Agile-Scrum methods to develop a control and monitoring system for the agricultural machine powered by a solar Photo Voltaic system, and uses a Brushless Direct Current Motor coupled with electric Solenoid valve, relay modules and a controller unit for the control process, and collecting motor operation data such as voltage and current. A developed mobile app acquires motor operation data offline, and delivers to a cloud server for analysis once in internet connection zone. This novel design provides an effective control and monitoring mechanism for a plethora of locally made agricultural machinery that are motor operable and readily available in our remote localities.

Online Real-Time Radiation Detector Monitor

Sibusiso Gift Ditsele[1], Vusumuzi Malele[1] and Pius Adewale Owolawi[1]
[1]Tshwane University of Technology, South Africa

Late detection of occupational radiation exposure has potential risks to health for clinical engineers. In South Africa dosimeter badges are used to monitor radiation exposure levels with readings only analyzed once a month. The latter creates an opportunity for clinical engineers to be exposed to unintended radiation exposure levels that might exceed standards and regulations. This paper aims to present an affordable online real-time, ionization-radiation detection device that prevents unintended radiation exposure through warning measures. This has been achieved through electronic circuitry with a Geiger Muller tube to detect ionization-radiation. The warning system was implemented using audible sound and blinking LEDs. Data signals from the circuit were processed using Python on Raspberry Pi 3B and sent via WIFI to an online server running influxDB for logging and analysis. The data was presented on a website using Grafana for plotting. This allowed data readings to be analyzed in real time from a remote location. Experimental testing assisted in reducing risk of unintended exposure with warnings triggered as the tester approached concealed radiation sources. The device achieved an approximate of 95% radiation detection accuracy within a radius of one meter from ionization-

radiation sources. The medical radiation environment is highly regulated and controlled; however, more measures need to be taken to ensure the elimination of ignorance and human error. Systems that are proactive in preventing errors are required to ensure safety and to enforce standards and regulation.

SESSION IA – SMART SYSTEMS DEVELOPMENT

Time: 09:00 – 16:30

Development of user-friendly digital library resource discovery tool to mitigate learners' technical hitches

Agrey Kato[1], Eric W. Steinhauer[1], Elizabeth Ludovick Temba[1], Michael Kisangiri[1] and Shubi Kaijage[1]

[1]Nelson Mandela African Institution of Science and Technology University, Tanzania

This article aims to improve the library Resource Discovery Tool (RDT) as a library catalog extension of the third generation that allows one search box to seem through various databases and repositories. Although RDT's interaction is considered positive for library users, issues of usability and accessibility related to user desires, needs, and preferences continue to be a problem. This article describes the technological methods, standards, and protocols required, and then establish RDT concerning the obstacles encountered. The problems were classified into three categories; operation issues, visual interface, and level of navigation. An alternative approach, supported by these categories to strengthen the usability and functionality of RDTs was an adaptation. For every specific category of problem, the description was handled with the objective of this paper to alleviate RDT usability and accessibility by indexing a variety of digital information resources beyond the library collections.

Developing an Automated Core Rolling Machine for The Metering Unit's Current Transformer

Rebecca Magomere[1], Michael Kisangiri[1] and Silas Mirau[1]

[1] Nelson Mandela African Institution of Science and Technology University, Tanzania

The emergence of automation has brought positive impacts on the development and production of goods in industries by turning difficult processes into simple, efficient, and

time-saving. Unlike the developed countries, most of the industrial processes in developing countries are unautomated and hence fail to win the world market due to low production. Taking a case study of Tanzania electrical equipment company (TANELEC) in Tanzania, the manufacturing of metering units is a challenge due to the difficulties of rolling the core steel of the metering units' current transformer (CT). Most of the tested metering units are not qualified due to mis-dimensions and gaps in the rolled core because of the current manual, tiresome, and dangerous process. So, the industry doesn't reach customers' needs. The findings from the respondents showed the need for a machine that automates the rolling of the core of the metering unit's CT which is the objective of the study. The study employed a qualitative research method to have a better understanding of the present process using Agile software development methodology based on the Extreme programming agile method. The developed machine has the intelligence of accepting and rolling only the required material which is ferromagnetic iron. It also allows the user to enter the dimensions and number of the core needed. The developed system can produce up to 60 cores per hour which ease the burden of production. So, the TANELEC industry can increase the metering units' production and hence meet the customers' demands on time.

A Web-Based Human Resource Management System with Machine Learning Techniques

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Human Resources Management (HRM) is a very important aspect of any organization as it involves several core company activities that include but are not limited to recruitment, training of employees, establishing a healthy company culture and alignment of employee performance with the company's strategic goals. HRM has evolved over the years from mere administrative duties such as processing employees' salaries to devising strategic policies for organizations. This paper presents a human resource management system in the form of an interactive web application integrated with machine learning models that are utilized in the employee recruitment process. The web application was developed using Hyper Text Mark Language (HTML), Cascading Style Sheets (CSS), bootstrap, JavaScript and the CodeIgniter framework. The MySQL database is used for storage as well as retrieval of system data. The system consists of six core modules of recruitment, employment onboarding and administration, leave management, payroll management, employment management and reporting. Three classification algorithms i.e., logistic regression, random forest classifier and Support Vector Machine (SVM) classifier were used in the training of the machine learning models for three job positions i.e., executive

secretary, principal internal auditor and principal human resources and administration. The random forest classifier demonstrated the best performance for both the principal human resource and administration and executive secretary job position with accuracies of 98.74% and 99.98% respectively while the SVM classifier exhibited the best performance for the principal internal auditor job position with an accuracy of 98.58%.

Development of a location-based app for the networking of researchers and industry personnel based on innovation

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This research addresses an imovative application, which was developed using the procedural model of imovation. This work aims at networking researchers and people from the industry. The first chapter, the introduction, shows the relevance of networking. In the second chapter, the Imovation process is described in detail. It is shown how the idea of an application can be realized with the process model of imovation. After the three steps of the imovation process have been worked out, a technical explanation and possible profit models for the application follow. With the help of the process model, a prototype app was developed. The paper concludes with the developed application, an evaluation, a summary of this work, and on further applications.

A Loan Application Management System for Efficient Loan Processing: A case of Muhimbili SACCOS LTD

Luciana Murimi[1], Marius Siebert[1], Godwin Salira[2], Elizabeth Mkoba[1] and Mussa Ally[1]
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Major parts of the population in emerging markets are still unbanked. The 2021 Global Findex Database shows that only 52% of Tanzanian adults own a formal financial account. Unbanked individuals cannot access capital to grow their businesses. In Tanzania, Savings and Credit Cooperative Organization Societies (SACCOS) have traditionally provided services and products such as loans and savings tailored to fit the needs of the financially excluded. By doing so, tremendous success has been achieved in attaining financial inclusion. However, inefficient manual business processes still pose a great challenge, hindering SACCOS performance and sustainability. Whereas digital solutions such

as web and mobile applications have been widely adopted to improve business processes in various sectors, this adoption has been quite slow in the SACCOS sector. Lack of affordable entry-level solutions has resulted in most SACCOS relying on manual paper-based processes. There is therefore need, for the design and implementation of affordable, entry-level digital solutions. This study presents the implementation of a loan application management system: a case of Muhimbili SACCOS LTD. Qualitative methods of data collection were used in identifying system requirements. An android tablet-based loan application management system was implemented, allowing loan officers to capture rich information required to determine members' loan eligibility. Through the application, loan officers can retrieve stored loan applications and generate the required templates needed for further processing. For integration with Core Banking System (CBS), a schema is generated that can be uploaded to the CBS for further loan processing. Thus, achieving an efficient loan application process.

Integrated Academic Programmes Information System for Inter-University Council of East Africa

Alban Manishimwe[1], Ben G. Ruhinda[2] and Juru M. Eglantine[2]

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International mobility in higher education is important due to its contribution towards diversification of the student body, improving global rankings, and in-come generation. Studies show that international students' mobility is greatly influenced by the cost of higher education programmes, financial and living costs present in the host country in comparison to future potential income that could be generated by taking up this international mobility, social political ties and trade flows between a student's home and host country promote students to seek educa-tion abroad.

Globally, mobility is influenced by push and pull factors such as few resources in universities, overcrowding in lecture halls and accommodation, arbitrary as-signment of majors or enrollment in second choice majors, prevalence of strikes and other financial woes, home political climate, funding opportunities, freedom of academic choices and greater opportunities to satisfy intellectual curiosity.

Academic mobility in East African is greatly affected by financial constraints and existence of an information gap which exists among universities and students.

This paper presents an Academic Programmes Information Management System to be hosted by the Inter-University Council for East Africa (IUCEA), in a bid to fill this information gap, make information on Universities and Programmes more accessible, and to support students' and staff mobility.

A Proposed framework for the role of information technology (IT) infrastructure for Administrators' effective remote working

Melinda Chakurira[1] and Michael Kyobe[1]
[1]University of Cape Town, South Africa

Adopting ICT infrastructure in remote working is a two-edged sword that can be critical for efficiency, smart decision-making, and effective communication. New IT technologies will make remote working more effective, lower barriers, and address issues that remote workers face, such as agency issues, inefficiencies, and cybersecurity. Despite its benefits, the adoption of ICT infrastructure in remote working has drawbacks, such as cyber security threats, and has a negative influence on the degree of benefits when compared to organizations that do not implement new ICT solutions. This paper aims to explain the causal effect of ICT Infrastructure on remote working, for administrative roles, and the major challenges impacting the relationship, by developing a comprehensive framework from four existing theories, namely the agency theory, the role theory, the Conceptual framework of IT Infrastructure for improved practices of MIS and the Cybersecurity framework, given the theories' limitations to better explaining the causal effect under study. The developed comprehensive framework will better explain the causal effect of ICT Infrastructure and remote working for Administrators, thereby adequately equipping organizations that aspire to adopt the concepts, as well as contributing to the body of knowledge.

Smart Energy Management System for Government Institutions: A Case of the Nelson Mandela African Institution of Science and Technology

Ateny Gabriel Aguto[1], Sanisse Adrielle Berinkinzo[1], Zacharie Niyonzima[1], Anael Sam[1] and Ramadhani Sinde[1]
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The energy consumed by the residential, commercial, and public sectors is a massive amount of energy that needs to be managed to avoid waste of energy through heating, lighting, and air-conditioning. Hence, there is a need to deploy an energy management system to drive down electricity consumption and cost and improve energy efficiency in the education sector. However, the Nelson Mandela African Institution of Science and Technology electrification system is analog. Such a system always leads to power wastage and high energy consumption. Sometimes, most security lights are kept on during the day when they should be at night. This causes a substantial monthly charge that impacts the budget of other sectors, such as research and development. The main focus of this study was to improve the energy management system through IoT technologies and automa-

tion of appliances (lights, fans, and air conditioners). A low-cost and effective Smart Energy Management System for Government Institutions has been developed to reduce energy consumption. The developed system uses the WSN and Wifi technologies to channel the energy consumption collected from various appliances and sections and relays it to the cloud. The qualitative and quantitative methods have been used in this research. Based on the results, the system enabled monitoring, control, and automation of lights, fans, and air conditioners and generated real-time live data. Furthermore, the user can access the system, control and monitor appliances online via a blynk web dashboard and mobile application, and receive notifications via GSM in case of internet failure.

Development of the web-based data-driven University Information Management System (UIMS) for the Inter-University Council for East Africa (IUCEA)

Abel Nshimiye[1], Mussa Dida Ally[1], Silas Steven Mirau[1] and Ben Ruhinda[2]

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A significant challenge faced by the Inter-University Council for East Africa (IUCEA) is the lack of a common University Information Management System (UIMS) for the East African Community (EAC) to manage information concerning the academic life cycle, assets, finance, and human resource. UIMS is among the modules of the Higher Education Information System (HEIS) for the East African Community (EAC), which aims to harmonize the region's education and training system in EAC. However, traditional high-education information management is not only costly but also ineffective. This work presents the development of a web-based data-driven University Information Management system (UIMS) for IUCEA to manage information about the academic life cycle, assets, finance, and human resource from all degrees awarding high education. In addition, this work added a university application portal to help high education institutions to apply for being among all degrees awarding high education. It has been developed using agile software development and web technology such as RESTful API, React, Django, and MySQL. UIMS for IUCEA will significantly impact the IUCEA's day-to-day operation and receive recognition from the surfer. In addition, it will improve the efficiency of many processes.

Embracing Sustainable Tourism Development through Information Communication Technology (ICT) in Tanzania: Analysis using Selected Tour Operators in Dar es Salaam

Juma James Masele[1] and Nassor Sadick[1]
[1]University of Dar es Salaam, Tanzania

The paper assessed the role of information communication technology (ICT) on sustainable tourism development in Tanzania. Specifically, the paper assessed the influence of three variables namely information management, community participation and efficient resource use through ICT on sustainable tourism development in Tanzania. A five points Likert scale structured questionnaire was used to gather field data from a sampled 90 tour operators' respondents. A Multiple regression analysis was done to describe the relationship between study variables. Results indicate a positive and significant influence of two variables - information management and efficient resource use on sustainable tourism development; while community participation's influence on sustainable tourism development was found positive. The implication of the findings is that ICT enhances sustainable tourism development in Tanzania as it facilitates information management and efficient resource use through ICT. The paper recommended that it is important for the firms and the government to promote and engage in the use of ICTs in tourism industry to enhance sustainable tourism development.

Design And Implementation of a Closed Loop Traffic Control System with Speed Control Influence on Proximity Vehicles, and Overriding Capabilities

Daniel Mkongo[1] and Zeeshan Khan[1]
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Normally the traffic control system as we know it is a non-intelligent system that operates as an open loop control system whereby traffic lights turn on and off following a preset time interval and sequence, with no regard for traffic density and with no direct emphasis on traffic rules. This opens up room for major traffic congestion, and road accidents even in well-developed cities with sophisticated land transportation infrastructures. Land transportation infrastructures in most developed cities cannot be expanded further and so it has be-come clear that we need to improve our traffic control systems, rather than trying to expand infrastructures, in order to effectively reduce traffic congestion and improve road safety through better traffic management. Poor traffic management systems cause fuel wastage, increased air pollution, time wastage, accidents and drives up stress, hence it is high time we improve traffic management systems to increase the overall quality of human life. This paper proposes a better traffic management system, which

seeks to improve on the existing system by utilizing sensors, radio transmitters, radio receivers, and computer software to detect and control traffic density, sense pedestrian presence as well as take action to emphasize speed limits by influencing vehicle speeds, both autonomously and through human intervention (overriding).

Explaining Changes in Short-term Water Demand Patterns During the COVID-19 Pandemic – An Absorptive Capacity Perspective

Michael Mattern[1]

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Embedded and mobile systems provide us with an ever-growing variety of potentially valuable information. Whilst collecting and storing such data may be a question of technology, our capacity to generate commercial benefits or public goods from them depends on the "absorptive capacity" of in-dividuals and social systems, for example the scientific community. Absorptive capacity – as defined by Cohen and Levinthal – is the ability to "recognize the value of new information, assimilate it, and apply it to commercial ends" [1]. With firms, absorptive capacity is often measured using surveys and subjective statements. When looking at research, however, one can also observe whether new information has been recognized, assimilated, and applied by reviewing scientific publications. Using publicly available data sources related to governmental non-pharmaceutical interventions (NPIs) and to changes in individual behavior during the COVID-19 pandemic as an example, we are attempting to evaluate whether information from these sources has been utilized to detect and explain changes in the short-term demand for water during the pandemic. Although we admittedly relied upon a simple, ad-hoc search algorithm, and although there may be a huge body of unpublished or confidential research, our findings still indicate that – even more than 2 ½ years after the start of what is probably the greatest health crisis in recent history – certain freely accessible and potentially valuable sources of information have only sporadically been considered.

Smart Industrial Electrical Energy Analytics and Forecasting System

Wayne Steven Okello[1], Jared Kelvin Nganyi[1], Gideon Muleme[1], Ramadhani Sinde[1] and Anael Elikana Sam[1]

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The rise of digital smart energy meters with advanced industrial communication protocols has availed opportunities to easily harvest utility energy data in the modern industry 4.0 era. Industrial utility load profile data aggregated over time can be used as a dataset

for the training machine learning models for the prediction of future consumption and accrued energy bill costs in an industrial setup. This paper presents a smart industrial electrical energy analytics and forecasting system that utilizes ultra-modern machine learning techniques to predict energy consumption and estimated energy bill based on historical data. An electronic data acquisition unit that comprises of a raspberry pi 4B, an industrial
energy protocol converter and a 3- phase smart energy meter was developed and deployed for data collection. Readings were stored locally on the raspberry pi every five minutes and synched to the cloud for redundancy purposes. Machine learning models were developed using the logged data to predict future energy consumption patterns. Two time series machine learning forecasting algorithms i.e., Facebook Prophet and Auto-Regressive Integrated Moving Average (ARIMA) were employed in training the model using the train dataset and exhibited Mean Absolute Percentage Error (MAPE) of 17.72 and 18.86 respectively when tested with unseen data. A web dashboard was developed to visualize readings from the data acquisition unit as well as forecasted energy trends from which different energy analysis and insights can be generated.

Mobile-Based Ticket Tracking Helpdesk System for Technical Support

Jacqueline Uwimbabazi[1], Anael Sam[1] and Devotha G Nyambo[1]
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Abstract: Mobile technology has provided a platform through which companies can reach their clients faster and address issues more conveniently. Habari node PLC manages and supports its customers through a web-based customer relationship management (CRM) System. The company receives customer support requests through phone calls, and the volume of phone calls from clients needing assistance is high due to its large customer size. Additionally, the number of clients joining them increases daily. This study aimed to develop a ticket-tracking helpdesk system that enables quick and effective customer service. At the initial stage, the study examined the existing system in order to have a list of requirements for the system to develop. The development and testing of the TTHS were done using an agile extreme programming approach. The developed system allows clients to submit their requests and for customer support staff to view these demands. The results show that the system allows opening and assigning tickets and then locates operations when closing tickets. In addition, the system provides SMS notifications between users. TTHS improves customer support service by 99.87% of efficiency by reducing response time, phone calls, and user data loss. Future work can be focused on developing a model for frequently asked questions.

Time: 09:00 – 10:20

The Role of Mobile Application to Control the Existing Customer Needs, Pains and Gains in the Municipal Solid Waste Collection Systems

Stanley Manyonyi[1], Silas Mirau[1], Mussa Ally[1] and Kuchibanda Kizito[1]
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Deaths are caused by breathing oxygen-deficient air all around the World. Nitrogen gas displaces oxygen in the air, bringing the percentage of oxygen down below 21% by volume, even if the number of fatalities varies from year to year and location to location. Particular environment/room, such as the High Purity Germanium Detector Room, requires tailor-made techniques to ensure that oxygen levels are properly monitored to avoid any hazard. This study was done at the High Purity Germanium Detector Room (HPGDR) at Tanzania Atomic Energy Commission (TAEC). In the project, we used V-Model, which works effectively for small projects where the requirements are clear. It was easy to check every step before proceeding to the next level of development, which led to development of an error-free and good-quality system. The ESP32 microcontroller was used because it is built in Wi-Fi which was used to send data to the cloud server. The developed system has four parts: The sensing part continuously monitors environmental parameters using Oxygen, MQ-135, and DHT22 sensors. The processing part processes and analyses the collected data from sensors. The notification part alerts the workers using buzzer and Short Message Service (SMS). While the control-ling component replaces the compressed air contaminant with outside fresh air. The developed system uses the Blynk Application to provide real-time monitoring. All the processed data could be accessed via mobile phones using the Blynk application. The system could alert workers by sending SMS to the subscribed phone numbers and switch on the exhaust fan automatically.

Social Sustainability in Times of Digitalization and Transformation: The Volkswagen Roadmap Digital Transformation

Eva-Maria Spindler[1] and Christoph Schank[2]
[1]Volkswagen AG, Germany
[2]University of Vechta, Germany

The automotive industry is undergoing the most comprehensive industry transformation in its history. The main drivers of this change are, on the one hand, new opportunities to make mobility more environmentally friendly through electrification and decarbonization, and, on the other hand, changing wishes, needs and expectations with regard to personal mobility, which can be met by networked systems and (partially) autonomous driving. Not only are fundamental drive models of cars and commercial vehicles being questioned, but digital assistance systems are also becoming an increasingly important component of vehicle equipment. This highly disruptive transformation process is accompanied by globally high-profile scandals that have shaken the very foundations of the industry leader Volkswagen AG ("dieselgate") in particular. This transformation process has long since threatened not only the profit expectations of shareholders, but also hundreds of thousands of jobs worldwide, on which not only individual livelihoods, but also entire social areas and global value chains depend. The shaping of transformation is thus necessarily also a question of social sustainability, which in turn is intricately linked to economic and ecological sustainability.Based on the concept of social sustainability, we want to use the example of Volkswagen AG to show how the legitimate claims of intra-organizational stakeholders, especially employees, can be negotiated and safeguarded in drastic transformation processes. In doing so, we describe a context that is strongly influenced by the German system of co-determination and thus show how participatory decision-making takes place in dynamic environments.

Mobile Based Application for E-services and E-payments A Study case of Habari Node Public Limited Company in Arusha, Tanzania

Umuhoza Ritha[1], Anael E. Sam[1] and Devotha G Nyambo[1]
[1]Nelson Mandela African Institution of Science and Technology University, Tanzania

Technology is being involved in different sectors to improve service delivery. Habari Node PLC (Public Limited Company) located in Arusha; Tanzania offers Interne Services as well as a variety of additional ICT-based business solutions, The company has a website which is used to provide information related to the services they provide with their cost. However, the current website isn't mobile user friendly and not integrated with an electronic payment to pay for those ser-vices because the payments are presently done

manually. This study aimed to develop a Mobile Based Application for E-services and E-payment which will al-low the user to access all information related to the services provides by this company and be able to perform e-payment to the subscribes services, the payment will be done through mobile money or credit card depending on the customer choices.

SESSION IIA – ARTIFICIAL INTELLIGENCE TOOLS AND APPLICATIONS

Time: 09:00 – 16:30

Contextual Multi-view Graph Community Detection using Graph Neural Networks

Chiheb Edine Zoghlemi[1], Abdelkerim Rezgui[1] and Nesrine Ben Yahia[3]
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In the last years, in order to better accommodate the increase of data volume and complexity, different data types have been presented. One of the most popular abstract data types (or known as data structure) is Graph. It is a complex data type that can capture and detail complex system components and relations. Graph data-structure is used in numerous industrial scenarios and domains such as social networks, e-commerce, marketing, chemistry, etc. Graph clustering is an analysis technique that aims to regroup a set of related vertices (nodes) in a graph. This technique plays an important role in various applications, for instance community detection. Community detection is a graph clustering technique that enables the recognition of densely connected communities (clusters) within a graph. However, the classical methods, that consider only single-view features and neglect the context, are insufficient. Then in industrial cases, graphs often contain multiple views and the context surrounding the graph may influence the community preference for vertices. To address this challenging problem, we introduce a Contextual Graph Clustering (CGC), a novel community detection approach for discovering communities within multi-view graphs with context consideration. This approach uses a graph auto encoder to transform every view feature in-to a lower space encoding. It combines the embeddings and the corresponding context using a fusion and context block. This block will apply the context directly on the embedding, then aggregates the embeddings

using an aggregation function. As a last step the aggregated embeddings will be used to detect the communities.

Object Detection Model for Poultry Diseases Diagnostics

Shabani Karim[1] and Dina Machuve[1]
[1]Nelson Mandela African Institution of Science and Technology, Tanzania

Poultry diseases lead to low productivity, economic losses, and high veterinary expenses for smallholder farmers in Tanzania. In this study, we developed a deep learning model for object detection task using YOLOv5 architecture. An open-source dataset of 1,117 fecal images annotated for object detection tasks in JSON format was used for training the model. The annotation heatmap across all classes indicated a good representation of all the four classes of the dataset. The metrics included mean average precision (mAP), recall, precision and confusion matrix. The best training results were obtained at epoch 506. The model was deployed on a web application using Streamlit framework. The application is suitable for the early detection of three poultry diseases namely Salmonella, Coccidiosis and Newcastle disease, and the healthy class. The object detection task indicates where in the fecal image the disease-causing sample is located. The object detection task improves the model explainability for target users which in this care are smallholder poultry farmers and agricultural experts.

Improved Medical Imaging Transfer learning through conflation of domain features

Raphael Wanjiku[1], Lawrence Nderu[1] and Michael Kimwele[1]
[1]Jomo Kenyatta University of Agriculture and Technology, Kenya

Transfer learning has made deep learning more accessible in many fields, such as medical imag-ing. However, data adaptation in medical imaging transfer learning remains a challenge. With the release of many pre-trained models, there is a need to address target data adaptation in these pre-trained modes. This paper proposes the use of conflation of textural features, testing it on three medical imaging datasets and two pre-trained models among them a MobileNetV2 to demonstrate the approach usefulness in mobile systems. From the experiments, it can be seen that selecting images with lower textural Kullback-Leibler divergence can improve the performance accuracy of the models by a margin of 13.17% in LBP and 6.47% for GLCM methods. This approach en-sures that the pre-

trained models can be used with much confidence and assist in generating more quality data samples for effective transfer.

Intermodal matching algorithm including public transportation and ride-hailing

Sven von Höveling[1], Cedrik Theesen[1], Anton Butenko[1] and Venkatesh Sasapu[1]
[1]Carl von Ossietzky University of Oldenburg, Germany

Mobility in traffic is an often discussed topic in a wide variety of forms. In this paper, we address the mobility of older people in rural areas by presenting a concept for an algorithm that offers intermodal routes between ride-hailing and public transportation. The algorithm is based on a previously published algorithm for ride-sharing that uses isochrones for detour limitation as a key difference to other solutions and that includes a social metric based on individual preferences as well as filters. We add some improvements, public transportation and especially the mentioned intermodal option. For simplicity and reasoned for the target group, we limit the number of changes between both ride-hailing and public transportation to 1. The concept as well as the planned implementation is done within the REMOBIAS project that addresses mobility in rural areas with the help of an interactive assistant.

Detecting Urgency in Multilingual Medical SMS in Kenya

Narshion Ngao[1], Zeyu Wang[2], Lawrence Nderu[1], Tobias Mwalili[1], Tal August[2] and Keshet Ronen[2]
[1]Jomo Kenyatta University of Agriculture and Technology, Kenya
[2]University of Washington, United States of America

Access to mobile phones in many low- and middle-income countries has increased exponentially over the last 20 years, providing an opportunity to connect patients with healthcare interventions through mobile phones (known as mobile health). A barrier to large-scale implementation of interactive mobile health interventions is the human effort needed to manage participant messages. In this study, we explore the use of natural language processing to improve healthcare workers' management of messages from pregnant and postpartum women in Kenya. Using multilingual, low-resource language text messages from the Mobile solutions for Women and Children's health (Mobile WACh NEO) study, we developed models to assess urgency of incoming messages. We evaluated models using a novel approach that focuses on clinical usefulness in either triaging or

prioritizing messages. Our best-performing models did not reach the threshold for clinical usefulness we set, but have the potential to improve nurse workflow and responsiveness to urgent messages.

A Contribution to the Development of Sustainable Target Value Streams with Machine Learning Considering Material Flow Cost

Mick Geisthardt[1] and Dr. Lutz Engel[1]
[1]Jade University of Applied Sciences, Germany

Within the scope of maximizing value creation and eliminating waste, value stream mapping is considered as a well-established lean management tool which overall results in incomplete improvements due to its sole concentration on waste types that are assessable via lead time. Since resource efficiency gains increasing importance for industrial production, existing research has extended value stream mapping by the concept of material flow cost accounting. This extension relativizes the given lead time exclusivity and enables material and energy-based wastes to be factored. During application of this extended value stream mapping significant expenses arise in terms of data acquisition and processing, as well as calculation complexity and time-cost balance. Value-adding utilization of rising volume and complexity of data for generation of new target value streams in direction of the ideal state through improvement teams seems to be no longer a viable solution. To contribute to the design of a suitable solution for the future, a machine learning based model concept is introduced as a hypothesis in this research paper. Within prospective application, this model concept enables to use traditional and extended KPIs of the current value stream as input. Through defined task, rules and the algorithm value-adding analysis can be performed and assist in discovery of target value streams through the resulting output. Overall, this digital application to be developed can thus assist improvement teams at their work and can contribute to discover waste-optimized and more sustainable target value streams in an industrial environment.

A systematic literature review toward standardization of business rules discovery in the context of Process Mining

Menna Wael[1] and Gamal Kassem[1]
[1]German University in Cairo, Egypt

The discovery of business rules helps an organization improve its business processes, increase its performance, and customize its information systems to meet the business

objectives. Data mining is a common method to discov-er business rules from the process event logs, in which different data mining algorithms can be applied to discover patterns or rules within the event log data. Moreover, standardizing the process of business rules discovery from the event logs using data mining algorithms requires the identification of the pattern types related to performing different data mining tasks on event log data, and the different analysis objectives for the discovery of business rules from event logs. It was found that no systematic review was previously con-ducted to collect this information, therefore, the focus of this paper is to conduct a systematic literature review to collect from current and previous research the different pattern types within the event log data that are related to the discovery of business rules and the different analysis objectives for the discovery of business rules from event logs. The systematic literature re-view performed in this paper followed the approach of Imran et al., (2022). The findings identified the common pattern types within event log data re-lated to performing different data mining tasks to discover business rules, as well as the different analysis objectives for the discovery of business rules from the event log.

Continuous feature vector construction for incremental learning on constrained devices

Daniel Alvarez-Coello[1] and Jorge Marx Gómez[1]

[1]Carl von Ossietzky University of Oldenburg, Germany

Decision-making is nowadays data-driven instead of merely intuition-oriented. A reasoning process that leads to a decision depends on knowledge and the available facts. When the data is raw, it may contain non-actionable facts that are hardly useful. Ideally, such facts registered with data must be relevant and represented in a human-understandable way. Hence, data processing and analysis steps are necessary to get facts that can lead to action. Unfortunately, some analyses are too hard for humans to handcraft a suitable solution. Machine Learning (ML) has proven to be an excellent choice for solving specific prediction tasks. In the case of data streams, special ML techniques consider the one-pass constraint and train the models incrementally. This paper proposes to train these incremental ML models with feature vectors that are generically formed. We demonstrate its usefulness using a time series classification task. Moreover, we position the proposed approach inside a larger design to improve the vehicle data semantics.

Screening Tool for Possible Cases of Type II Diabetes Using Machine Learning in An African Context

Henry Semakula[1]
[1]ISBAT University, Uganda

Diabetes is a chronic, metabolic disease characterized by elevated levels of blood glucose or blood sugar that over time can bring serious damage to vital organs including the heart, blood vessels, kidneys and nerves. Type 2 diabetes usually occurs in adults, either due to inadequate insulin production, or because the body's cells do not respond properly to insulin. There has been scaled up purchasing and distribution of diagnostic kits but the majority of the population has not been reached. Predictive models have been developed for Type 2 diabetes, but African populations are not widely included in the datasets. The developed models may therefore not accurately identify at-risk populations in the African context. This paper presents a developed machine learning prediction model to identify Ugandans likely to be suffering from Type 2 Diabetes based on input symptoms. Random Forest, Support Vector Machine, Naïve Bayes, and Ada Boost classifier were trained on anonymized, real patient data with twelve risk factors related to the disease. This research's experimental results after comparison of the Accuracy Score and Confusion Matrix for all the above algorithms, Random Forest Classifier emerged the best with the Accuracy Score of 85.4% as being significant superior.

Influence of Microservice Design Patterns for Data Science Workflows

Christoph Schröer[1], Raphael Holtmann[1], Jorge Marx Gómez[1] and Hergen Pargmann[2]
[1]Carl von Ossietzky University of Oldenburg, Germany
[4]Jade University of Applied Sciences, Germany

Due to several advantages like scalability or fast development cycles, microservice architectures could also support the development and deployment of data science workflows. In recent literature, many patterns for the development of microservice architectures have evolved mainly for transaction-oriented applications. This paper aims to investigate suitable design patterns for data science workflows. For this, we will implement a data science workflow using a microservice architecture, implemented with two different patterns, the orchestrator and choreography patterns, and with synchronous and asynchronous communication. Experiments are conducted to compare these architecture patterns with workloads of volume and velocity criteria. Orchestrator pattern performs best and could be used for inference, while choreography pattern could be used for training of machine learning models due to asynchronous communication. Our paper can provide practical support to software architects in implementing data science workflows using appropriate microservice design patterns. Theoretically, we have linked relevant microservices pattern to data science workflows.

Convolutional Neural Network deep learning model for early detection of streak virus and lethal necrosis in maize: A case of Northern-highlands, Tanzania

Flavia Mayo[1] and Neema Mduma[1]
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The food crop is dominated by the maize crop, which is primary used as food, and a significant crop accounting for about 45% of the country's farmland. However, the productivity of this main crop is hindered by the diseases that are later detected by farmers, leading to poor quality and quantity of the maize plant. The serious diseases are maize steak virus and maize lethal necrosis, which would be cured if early detected by farmers. That being the case, this study aims at filling the gap by investigating the need and development of a deep learning model for early detection of maize diseases in Tanzania specifically those mentioned above. In this study, we developed a deep learning solution based on Convolution Neural Networks (CNN) to predict the early occurrence of this diseases in maize leaves plant. A baseline convolutional neural network was developed from scratch. A total amount of 1500 dataset belonging to three classes namely; healthy, MLN and MSV was used to train the model which attained an accuracy of 95.9%. The results show that the prediction accuracy is great and can be suitable for maize disease detection, however we plan to develop pre-trained models to compare the results with those already attained, and select the best model to be deployed in a mobile device for early detection and testing in a real life environment.

Machine Learning Model for Predicting Construction Project Success in Tanzania

Astin Ntulo[1], Elizabeth Mkoba[1], Dina Machuve[1] and Sanket Pandhare[1]
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The construction projects in Tanzania mainly use the post implementation evaluation method to determine the project completion success. This traditional method led to the discovery of errors and mistakes of projects execution only after the project is completed. These errors and mistakes can be avoided only if the construction project implementation were to be monitored in real time by using ma-chine learning models. The purpose of this paper is to present a machine learning model for predicting construction projects success in Tanzania using random forest ensemble learning algorithm. Research methodology employed quantitative and qualitative methods. Data were collected from 26 regions of Tanzania main-land. A total of 100 respondents of which are contractors and consultants for construction projects were involved in data collection process through

questionnaire and expert interview to identify factors influencing construction project success. Generative Adversarial Network (GANs) were used to expand the dataset to 1082. The model was developed, trained and tested. The model had accuracy of 97.5% and was deployed in a web-based application. The contribution of this study is to provide a tool that can be used by practitioners and policy makers to predict construction project success in Tanzania.

Visualizing Outlier Explanations for Mixed-type Data

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Outlier explanation approaches are used to support analysts in investigating outliers, especially those detected by methods which are not intuitively interpretable such as deep learning or ensemble approaches. Of the existing studies, few consider how the obtained explanations can be visualized. Two studies exist that utilize two-dimensional scatterplots for visualizing outliers detected on numerical data. None of the existing studies explore how outlier explanation obtained for mixed-type data can be visualized. In this paper, we propose an approach for visualization that can work in tandem with recently proposed explanation approaches. For this, we use the output of the explanation method to propose multiple adaptions to parallel coordinate plots to further aid analysts in the inspection of outliers detected on mixed-type data. We evaluate our approach by conducting a focus group with potential users of the method. The focus group shows the general efficacy of the approach but also highlights avenues for further improvements.

From Process Mining to Enterprise Mining

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In digitization projects a detailed determination of the current situation and validation of the achievement of objectives is usually associated with a great deal of effort and has an impact on all subsequent project phases. While already productive ERP systems in companies typically contain both business and technical information from all departments, many companies fail to collect this information in its entirety in an automated manner, to then consolidate it for a holistic overview of the company which can be used as a foundation for databased decision making in certain project phases. To make this easier, this

research introduces the term enterprise mining and develops a concept for it that consists of one specific information architecture and automated data collection procedures for ERP systems. The information architecture has 8 enterprise maps and provides orientation for which information should be collected for a holistic overview on an enterprise with the selected technical data collection procedures.

SESSION IIB – ARTIFICIAL INTELLIGENCE TOOLS AND APPLICATIONS

Time: 10:50 – 16:30

Determining Emotion Intensities from Audio Data Using a Convolutional Neural Network

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Human beings communicate their feelings in form of emotions. The feelings are expressed via speech, facial expressions, gestures or other non-verbal signs. An emotion is a complex severe disturbance of an individual's mental state that involves a subjective experience coupled with physiological, behavioral and expressive response. It denotes the mental state of the human mind and thought processes that represent a recognizable pattern. The emotions can be expressed with normal intensity or strong intensity depending on the incident being communicated. Detecting and classifying these emotions encompasses three fundamental machine learning process; Feature Extraction, Feature Selection and Feature Classification. Machine learning is the science of making computers learn and act like humans, while enhancing the learning with time in an independent manner, by giving them data and information in form of observations and real-world interactions. A multi modal approach comprising of several machine learning algorithms is required to map out the intensities contained in the emotion classes. Mel Frequency Cepstral Coefficients are a set of about 10-20 features obtained from a speech signal describing the overall shape of a spectral envelope. The MFCC algorithm is designed to mimic the human hearing, thus it is ideal for this experiment.

Improving Robustness of Optimized Parameters Gradient Tree Boosting for Crime Forecast Model

Godfrey Justo[1], Leonard Binamungu[1] and Festo Clemence[1]
[1]University of Dar es Salaam, Tanzania

The rise in crime rate poses significant problems to societies around the world. Departments responsible for public security spend a lot of time looking for ways of combating crime and adapting their policing techniques to curb the rising crime trends. The application of artificial intelligence for crime forecasting through optimized parameters of gradient tree boosting using dragonfly algorithm (DA-GTB) has recently attracted research attention. However, the DA-GTB is affected by loss function that calculates pseudo-responses-value, in which by default uses the least absolute deviation (LAD) loss function. Motivated by the role and limitation of loss function, this research sought to determine DA-GTB crime forecast model using a loss function that improve the model's predictive performance. Three crime type data from Tanzania Police force that cover ten years was used. Through [12], four-candidate loss functions were identified and applied experimentally to determine best performing loss function. The evaluation showed that the Huber loss function with optimal-alpha (α): 0.15, 0.09 and 0.15 parameters with respect to crime types outperformed other loss functions by average of 2% as it achieved the lowest error compared to others. Thus, the Huber loss function with the attained α parameters improves the DA-GTB crime forecast model.

Feature Selection Approach to Improve Malaria Diagnosis Model's Performance for High and Low Endemic Areas of Tanzania

Martina Mariki[1], Neema Mduma[1] and Elizabeth Mkoba[1]
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Malaria remains a significant cause of death, especially in sub-Saharan Africa, with about 228 million malaria cases worldwide. Parasitological tests, in the form of microscopic and rapid diagnostic tests (RDT), are the recommended and standard tools for diagnosing malaria. However, in areas where parasitological tests for malaria are not readily available, clinical diagnosis is advised. This method is the least expensive and most widely practiced. A clinical diagnosis called presumptive treatment is based on the patient's signs and symptoms and physical findings at the examination. A malaria diagnosis dataset was extracted from patients' files from four (4) identified health facilities in the regions of Kilimanjaro and Morogoro. These regions were selected to represent the country's high-endemic areas (Morogoro) and low-endemic areas (Kilimanjaro). The dataset contained 2556 instances and 36 variables. The random forest classifier, a tree-based, was used to

select the most important features for malaria prediction. Regional-based features were obtained to facilitate accurate prediction. The feature ranking indicated that fever is universally the most noteworthy feature for predicting malaria, followed by general body malaise, vomiting and headache. However, these features are ranked differently across the regional datasets. Subsequently, six predictive models, using important features selected by the feature selection method, were used to evaluate the performance of the features. The features identified complies with malaria diagnosis and treatment guidelines provided by WHO and Tanzania Mainland. The compliance is observed to produce a prediction model that will fit in the current healthcare provision system.

Application of multiple Time Series Models for Forecasting New and Relapse Tuberculosis Cases : A case of Kibong'oto Infectious Disease Hospital in Tanzania

Eunice Silas[1], Devotha G Nyambo[1], Anael Sam[1], Elizabeth Mkoba[1] and Sanket Pandhare[1]
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Tuberculosis (TB) is a chronic infectious disease that contributes to the re-duction of manpower in developing countries and untold suffering to those it infects. Since TB has a seasonal variation in different parts of the world and no consistent pattern has been observed, hence existing forecasting models cannot be generalized. The study aimed to develop a forecasting model for TB cases at the Kibong'oto Infectious Disease Hospital (KIDH). A total of 3911 new and relapsed TB cases were collected from KIDH (from January 2015 to December 2020), and 69% of the dataset was used for the training model, while the remaining 31% was used for testing. The Holt-Winters, ARIMA, and LSTM models were trained and fitted to the dataset. The value of Root Means Square Error (RMSE), Mean Absolute Error (MAE), and Mean Percentage Absolute Error (MAPE) were used to evaluate the suitability of the model. The model that perform better was the LSTM model with lower error metric values for MAE, MAPE, and RMSE (7.0079, 0.1513, and 2.9576, respectively) as compared with Holt Winter's and ARIMA model. Also, the fore-casted result indicates an upward trend which threatens the sustainable development goal. Therefore, the study fills the gap in modeling monthly TB cases in order to capture monthly pattern. Also accurate forecasting of new and relapse TB cases at KIDH is needed to allocate the limited resources more efficiently.

A Comparative Study of some Pre-Trained Models on Transfer Learning Approach in Detection and Classification of Cassava Leaf Diseases

Emmanuel Ahishakiye[1], Waweru Mwangi[2], Petronilla Murithi[2], Danison Taremwa[1], Fredrick Kanobe[1] and Ruth Wario[3]

[1]Kyambogo University, Uganda

[2]Jomo Kenyatta University of Agriculture and Technology, Kenya

[3]University of Free State, South Africa

Cassava diseases affect cassava harvest posing the greatest danger to the food security and livelihoods of more than 200 million people. To identify cassava diseases, government professionals visit various sections of the country and visually score the plants by looking for disease indicators on the leaves. This procedure is notoriously subjective; it is not uncommon for specialists to differ on a plant's diagnosis. Automating the detection and classification of crop diseases could help professionals diagnose diseases more accurately and allow farmers in remote locations to monitor their crops without the help of specialists. Machine learning algorithms have been used in the early detection and classification of crop diseases. Motivated by the current developments and many influential studies in the field of deep learning and transfer learning models in the detection and classification of crop diseases, this study evaluates the performance of VGG16, VGG19, ResNet50, InceptionV3, DenseNet201, and MobileNetV2 in detection and classification of cassava leaf diseases. Fine-tuning of the hyperparameters was done during training to improve the accuracy of the models. Experimental results on the cassava dataset revealed that InceptionV3, DenseNet201, and MobileNetV2 models had high training accuracy but low validation accuracy with various epochs which means that they had issues with overfitting while ResNet50 had issues with underfitting. Moreso, VGG16 and VGG19 models performed well on both training and validation datasets, though VGG16 performed relatively well compared to VGG19.

Machine Learning Based Forward Collision Avoidance System: A Case study for the Kayoola EVS

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[2]Kiira Motors Corporation

Forward collision avoidance system is an advanced driver assistance system that alerts the driver or maneuvers for safe motion in case of the occurrence of an imminent collision. In this research an efficient reinforcement learning algorithm that actuates the car

to move forward, steer left, right and stop was designed for autonomous vehicles. Currently forward collision avoidance systems are based on input commands from the sensors like Lidar and Cam-era to the system and the output is based on the commands initialized. With this model the vehicle gathers data using an RGB Camera and collision sensor while moving on the road in a simulated environment. Scenarios are developed which include car moving around corners, straight road and in a more urban layout with other obstacles like cars within the environment. Reward flags are given for no collision and penalty for collision with obstacles within the environment. Model testing was done in Carla simulator and analysis of the model was done on a Tensor board and recorded simulation as the vehicles moves within the environment. An optimized deep Q-learning algorithm that relies on deep reinforcement learning was developed under constrained conditions in a Carla simulation environment with an overall ac-curacy of 64% and a metric loss of 20%. The algorithm relies on dynamic programming which can buffer data during the training process.

2-Stage Hybrid Based Heterogeneous Ensemble Committee Machine for Improving Soil Fertility Status Prediction Performance

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Adequate and accurate information about the soil is one of the key basic fundamental factors for optimal decision-making and sustainably improving crop productivity. Contemporarily, advanced machine learning (ML) modelling techniques have been useful in delivering actionable information in various fields. In agriculture, soils in particular, the same has been the case whereby ML models are being developed for various tasks including soil nutrients analysis and fertility status predictions, as well as determination of appropriate crop for plantation, amongst others. There exists much exploration in ML models for soil nutrients, compounds, and its key chemical possessions classification and prediction. However, varying predictive performances have been demonstrated by in predicting the soil fertility status. In addition, a range of varying fertility status levels have been synthesized and used for modelling classifiers targets for predicting soil fertility. This paper presents a high performance throughput 2S-HHEC combining a neural network, decision tree, random forest, support vector machine, and gradient boosting classifiers to predict soil fertility status with ac-curacy and Kappa score of 98.93% and 93.9% on test data.

Mask R-CNN model for banana disease segmentation

Christian Elinisa[1] and Neema Mduma[2]
[1]Nelson Mandela African Institution of Science and Technology, Tanzania

Early detection of banana diseases is necessary to develop the effective control plans and minimize quality and financial losses. Fusarium Wilt Race 1 and Black Sigatoka diseases are among the most harmful banana diseases globally. In this study, we propose a model based on the Mask R-CNN architecture to effectively segment the damage of these two banana diseases. We also include a CNN model for classifying these diseases. We used an image dataset of 6000 banana leaves and stalks collected in the field. In our experiment, Mask R-CNN achieved a mean Average Precision of 0.04529, while CNN model achieved an accuracy of 33%. The Mask R-CNN model was able to accurately segment areas where the banana leaves and stalk were affected by Black Sigatoka and Fusarium Wilt Race 1 diseases in the image dataset. This model can assist farmers to take re-quired measures for early controlling and minimizing the harmful effects of these diseases and rescue their yields.

A machine Learning Prediction Tool for Dolutegravir Associated Hyperglycemia for People Living with HIV in Uganda

Ceaser Wisdom Favor[1], Sinde Ramadhan[1], Michael Kisangiri[1], Levicatus Mugenyi[2], Francis Musinguzi[3], Martin Balaba[3], Noela Owarwo[3], Eva Laker[3], Ruth Obaikol[3], Agnes Kiraga[3], Barbara Castelnuovo[3] and Rosalind Parkes Ratanshi[3]
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[2]The AIDS Support Organisation, Tanzania
[3]Infectious Disease Institute (IDI), Uganda

Dolutegravir-based antiretroviral is a second therapy provides a potent treatment option for persons living with HIV (PLWH). While incidence and prevalence rates are unclear among PLWH, clinical research has shown that the use of Dolutegravir (DTG) results in momentous hyperglycemia (Odenyo, 2020). Identification of patients at risk of DTG-associated hyperglycemia if switched to dolutegravir would allow for DTG to be avoided in this PLWH, hence preventing morbidity and mortality in this group. A machine learning prediction tool was developed and evaluated. We used machine learning classification methods applied to longitudinal cohort secondary data of 9077 treatment-experienced participants. DTG-associated hyperglycemia risk factors were used as model features (table1). The data was split into training and testing datasets in a ratio of 2:1. A total of 6807 records were allocated for models training, seven trained models from which Ran-dom forest and Extreme gradient boost (XG-Boost) performed best with model accuracy

of 0.99 each. Among others, the study found XG-Boost model with the best classification; accuracy of 0.93, the probability to classify positives of 0.87, a precision probability of predicting positives of 0.67, area under the receiver operating characteristic curve of 0.90, area under the precision-recall curve of 0.86, an F1 score of 0.76, and a Cohen Kappa score of 0.72. The positive predictive value, sensitivity receive operating Curve, and the precision-recall area under a curve suggested the XG-Boost model as the most suitable for development development of the prediction tool. It was implicit enough to say machine learning techniques can be applied to datasets of cohorts of PLWH to assist with selection of most appropriate and safest ART regimens for individual PLWH. Machine learning DTG-associated hyperglycemia prediction tools should be used to aid in precisely predicting development of hyperglycemia among HIV treatment-experienced patients being switched to DTG in Uganda.

The artificial neural network-based smart number plate for vehicles with real-time traffic signs recognition and notification

Alexandre Niyomugaba[1], Neema Mduma[1] and Michael Kisangiri[1]
[1]Nelson Mandela African Institution of Science and Technology, Tanzania

The world is advancing technologically in all sectors, including intelligent transportation, whereby various vehicles' movements are monitored and con-trolled remotely. These technologies simplify the tasks in traffic control and in-crease road safety. The previous related works implemented and designed provided different technologies that can identify, locate and detect the vehicle's speed. Even though these technologies have been implemented, there is still a lack of assistance to drivers for earlier knowing the road situation and real-time accident notification to dedicated authorities such as traffic police stations. In this paper an Artificial Neural Network based smart number plate with real-time traffic sign recognition and notification was developed. The developed number plate comprises with two units, the processing unit and the display unit which both communicate through wireless communication. The processing unit contains a speed sensor and vibration shock sensors, Global System for Mobile communication, Global Position System and Raspberry Pi 3 B+ that act as micro-controller board. The display unit contains the Expressif board, Liquid crystal Display (LCD), and Buzzer. With the TensorFlow model for machine learning, the smart number plate classifies and recognizes traffic signs with real-time notification. Moreover, this number plate had been tested to different drivers and assisted them in obeying the traffic signs earlier, and the traffic station had been alerted for emergency support.

The States Perspective of Blockchain - A Qualitative Content Analysis

Hauke Precht[1], Tim Siedenburg[1], Jorge Marx Gómez[1]
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Currently, blockchain is mostly considered from an economics perspective followed by scientific approaches. A analysis of viewpoints from a governmental perspective is missing to this date. Therefore, we raised the research question ”What are the general views of the world’s six most economically powerful countries on blockchain technology?”. To answer this research question, we performed a qualitative content analysis for the blockchain strategy paper by the six largest states by Gross Domestic Product. By using inductive category building, we were able to code statements into 28 identified categories. With these categories, we create three alternative main categories: rather positive views, rather neutral views, rather negative views. By doing so, we were able to show that, all six states considered, the views are rather positive (58.7% of statements) or rather neutral (35.2%). Only 6.1% of statements were coded as rather negative. With this, we can state that, in general, states are positive about blockchain technology and it’s possibilities and influences

A Proposal to Store Remote Monitoring Sensor Data in a distributed manner, using IOTA Streams and IPFS

Ali Aminrezaei[1] and Jorge Marx Gómez[1]
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Since the advent of the introduction of blockchain technology, there has been extensive research and discussion on the use-cases of applying DLT. Numerous researches have been shown, the health care sector as one of the sectors that can gain benefit from applying distributed ledger technology. The health-care concept leads toward perfection by the increase of the care volume that the patient becomes. The care volume in clinical term can be interprets remaining under monitoring. However, because of the limited resources, the monitoring volume that can be applied is also limited. Using IoT sensors can reduce the load of monitoring. However, there are various approaches to manage these sensor values data. The proposed architecture in this paper, suggesting a novel

approach toward storing sensor data, in a distributed manner; which using IOTA Streams to issue access control to the data stored on orbitdb ipfs based database.

Predictors of E-Government Adoption in Developing countries: A survey in South Africa

Anass Bayaga[1]

[1]Nelson Mandela University, South Africa

While interest in e-government service adoption is on the rise worldwide and in different blocks (west, east, central, and north) of Africa, little research particularly in southern African countries such as South Africa exists to ex-amine security risk predictors and sociocultural factors which collectively are termed institutional logics. The current research examines security risk predictors and institutional logic's influence in adopting e-government services. Guided by the research aim, a questionnaire was used to randomly stratify four hundred and twenty (420) respondents through a survey, wherein structural equation modeling was employed as analytic tool. While, fundamentally, the results revealed the need to include security risks factors in adopting e-government services, the effects of institutional logic and security risks as influencers are independent of e-government service adoption. Conclusively, while evidence related to the use of public sector web such as e-government services largely depend on key security risk predictors, they are exclusive of institutional logics factors.

DLT Architecture Proposal for IoT applications based on Data Streams

Francisco Moya[1], Luis Martínez[1], Francisco Estrella[1], Rafael Espín[2], and Jorge Marx Gómez[3]

[1]University of Jáen, Spain

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Millions of sensor-based devices are now continuously transmitting data, which is key for solving real-world situations. Due to their low cost together the support to implement easy real-world solutions, such as devices and their generated data streams are crucial nowadays. Despite the ease with which both devices and their data streams may be altered, the processes required to transfer data collected to final analysis—which involve data transformation and variable creation—present a significant issue to researched since such data must be secured in applications. Systems can be endowed with characteristics like resilience against the advent of single points of failure or resistance to infor-

mation manipulation by means of Distributed Ledger Technologies (DLT). DLT has the capacity to create sensor-based solutions with properties that would enable the creation of a broader variety of potential solutions. This contribution introduces a platform for gathering data streams from sensor-based devices and publishing them on a DLT Infrastructure (DLTI). We present and justify the platform's interface layers, i.e., data gathering and publication on a DLTI.

Blockchain-based Crowdfunding Charity Platform

Prithivi Rao Appadoo[1] and Roopesh Kevin Sungkur[1]

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Traditional crowdfunding platforms are still using the same centralized architecture that has been around for decades to allow contributions to be made for funding of project or venture on the internet. With time, no significant improvements have been made to solve the flaws of the system and the problems have remained intact. The lack in transparency is the cause of the low trust and credibility between funders and fundraiser therefore the reason low success of campaigns and platforms. Additionally, information such as bank credentials is not secure and malicious actions can occur. The lack of security leads to a decrease in the number of users. This research tackles the problems mentioned above with the implementation of the blockchain technology to come up with a new and improved crowdfunding platform developed using Ethereum. The programming language that was used for the front-end is React.js and for the backend is Solidity for the smart contracts. The whole system is a web-based application. The system is connected to metamask and users must have an Ethereum account for login on their account on metamask to get access to the crowdfunding system.The results obtained were very encouraging and the system proposed provided increased transparency, security, usability and availability. Future works include additional security features so as to ensure that no malicious action can occur. Additionally, contribution should be able to done using several different cryptocurrencies so as to allow a greater range of users to use the system

A Conceptual Model of the Benefits and Concerns of Wearable Health Data Management

Lydia Izu[1], Brenda Scholt[1] and Ifeoluwapo Fashoro[1]
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The wealth of data provided by wearable technologies can provide many advantages to stakeholders. As a result, empowered consumers have developed growing expectations for personalized engagement in many aspects of their daily lives, including health care. However, the proliferation of health data generated by wearable technologies presents both opportunities and challenges. Challenges arise when there is a gap in the management of wearable health data such as the lack of adequate regulations to govern and use data. The opportunities lie in the proper management of wearable health data where measures are implemented to ensure that data quality and privacy are upheld and data ownership, access and use are defined. This paper explored the benefits and concerns of wearable health data management using a Systematic Literature Review (SLR) and conceptual analysis. The contribution is a conceptual model of the benefits and concerns of wearable health data management. The model highlights that data quality, privacy, security and governance are both prevalent benefits and concerns regarding wearable health data, whereas data ownership and accessibility were highlighted as the main concerns of wearable health data management.

The Data Value Chain Definition

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“Data is the new oil” is a term coined by previous research to describe data as the fuel for the next industrial revolution. But like oil, the process of refining data is complex and requires multiple steps. On the path to value creation, data scientists must ensure that the way they process data matches the perceived value to users of analytics results, such as decision makers. The requirements of decision mak-ers in this regard can vary widely depending on the application domain. At the same time, these requirements meet individually different infrastructures for data. In order to better align and later optimize this mismatch between requirements and opportunities, it is necessary to clearly define and delineate different steps of data value creation. The goal of this paper is to develop a definition for a data value chain from the literature. This definition will enable practitioners and researchers to discuss and further refine data value chains from different application domains.

Computational model and monitoring in comprehensive medical care for COPD patients, based on telemedicine.

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[2]Universitat Autònoma de Barcelona

The monitoring and consultation of the data is a bidirectional sys-tem, which seeks to have an impact on the patient's quality of life and the reduction of crises per year, reducing the number of times the patient has to go to a health center or even be hospitalized. The computational process based on monitoring, follow-up and assess-ment facilitates COPD patients to send data collected in the comfort of the home, which allows to measure and diagnose the patient au-tomatically through the mobile application, a COPD patient will be trained to acquire a sufficient degree of training to take samples and send the information through the application to the relevant health service without having to mobilize physically, thus becoming an empowered patient, the objective is to analyze the impact of the use of this technology on the quality of life of the patient and the poten-tial benefits in the health system.

Development of an Arithmetic Video Game and Console for Standard I and II Pupils in Tanzania

Winny Bundotich[1], Luciana Murimi[1], Alvareze Ntafatiro[1], Michael Kisangiri[1] and Devotha G Nyambo[1]
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Through game-based learning, new concepts have been introduced to learners in a simplified and engaging manner. Numerous games have been developed; however, there is a need for an educational game that follows Tanza-nia's curriculum and fits its context. This paper, therefore, presents a video game and console to aid in learning arithmetic concepts for standards I and II learners in Tanzania. The game content matches the Tanzanian syllabus, and its settings suitably fit the context. This game, named math bubbles, pays attention to pedagogy, game mechanics, incentive system, narrative and aesthetic design. The game's design provides a high interactivity level and promotes intrinsic motivation and self-learning. The game console comprises a rechargeable, lightweight, hand-held device, having a 7-inch LCD and push buttons used to interact with the game. A web application with a simple interface was developed to help the teachers track learners' performance. Twenty people (curriculum experts, teachers and learners) were engaged in the data collection for functional, educational, pedagogical and non-functional requirements. Fifteen standard I and II learners played the game in two phases. In the first phase,

learners played with the teachers' help. In the second phase, they played on their own. The curriculum experts and teachers also interacted with the game. All participants filled out a game evaluation form assessing the game's effectiveness. The responses were positive; however, the learners' time exposure was limited. The Curriculum experts recommended the integration of the math bubbles game and console into classroom learning to enhance the pupil's arithmetic competency.

SESSION IV – Wireless and Mobile Computing

Time: 9:00 – 10:15

IoT Based-System for Fire Detection and Aviation Obstruction Light Monitoring

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Telecommunication towers have appreciable applications in communication technology. However, they are challenged with system breaks down resulting in fire outbreaks and aviation obstruction light which causes accidents for aircraft at night. Mitigations to curtail these challenges are equally difficult due outskirt location of the tower. Hence, it becomes imperative to set up an automated programmed fire detection system. This paper proposes an IoT based-system for telecom tower fire detection and aviation obstruction light monitoring to be used in towers everywhere they are implemented. The pro-posed solution is incorporated an automatic fire extinguisher and real-time monitoring of the aviation obstruction light status. The integration of components for sensing the flame, ESP32 WROOM-32D as a microcontroller, Buzzer, the ambient light of the aviation light, darkness sensor and Pzem-004t for power control. The global service message module (GSM) was used to alert all tower technicians and firefighters with remote monitoring through mobile applications and web-based. The results showed that the system can detect and extinguish the fire, monitor the aviation light for tower safety, make the call as well as send Short Message Service (SMS). Therefore, the technicians were safe for the developed system because of the remote system in all telecommunication towers rather go for manually checking without knowing the issue.

A Digital Twin Approach and Challenges for Real-time Automated Surface-drip Irrigation Monitoring: A Case of Arusha Tanzania

Joseph Wangere[1], Ramadhani Sinde[1], Mussa Ally[1] and Omary Mbwambo[1]
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Irrigation monitoring has become an inevitable tool for conserving water which is a scarce resource. As weather patterns become more unpredictable, with sporadic rainfall, drought is proving to be a more common phenome-non. Despite efforts by researchers within the confines of the fourth industrial revolution to propose methods for automating irrigation systems, there is a need to catch-up with latest technological trends that combine a multi-faceted approach for integrating smart technologies with human interaction and intellect to provide a combined approach that is more accurate in providing a real-time experience for remote monitoring and control of irrigation systems as the world shifts into the fifth industrial revolution. This paper provides an overview of digital twin technology and proposes how it can be adopted in the development of a real-time and automated irrigation monitoring system. For practicality, the proposed digital twin can be incorporated in an existing manual irrigation system thus minimizing the need for complete overhaul of pre-existing manual systems, and keeping the cost of implementtation within affordable range for low-income markets. The challenges that face digital twin implementation for irrigation automation have also been highlighted with possible remedies.

IoT on Newborn Room Temperature Control System with Fire Detector: Case Study at Meru Hospital

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Hypothermia is a serious problem that infants face around the world. Several strategies have been put forth to address this issue. However, the existing system lack control facilities and communication mean for nurses and technicians. This project focuses on the improvement of the methods undertaken to fight the hypothermia problem as it contributes to 19% of deaths among newborns in Tanzania. Currently, Mount Meru hospital in Arusha uses overhead heaters to warm the room for newborns. This study developed a system that can provide automatic control of the heater, and communication about the room to nurses and the technical team. The system comprises a sensing unit that read environmental parameters using temperature and humidity sensor (DHT22) and smoke sensors. Two pairs of heaters with two heaters work at a time and the other two for standby. The controlling unit (Atmega 328) receives, analyses, and processes the col-

lected data from sensors and does the necessary. The system uses the Global System for Mobile Communication (GSM) to send a Short Message Service alert to the technical team whenever there is a system fault. LoRA technology is used to establish communication between the controlled room and the nurse room so that the nurses can see the environmental condition of the room in real-time. The system switches ON or OFF heaters if the temperature is lower or higher than the threshold value respectively. When one heater fails, the system turns ON the standby one and sends an SMS to the technician requesting repair.

IoT-Based Monitoring and Reporting System for Dosimeter Wearers in Radiation Areas

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The utilization of radiation sources in a variety of activities has rapidly in-creased in today's modern civilization. As a result, occupational exposure to ionizing radiation doses that cause health effects increases. Excessive doses of 20 millisieverts (mSv) per year cause acute effects such as sterility or cancer. Ionizing radiation has a negative impact on human health. In Tanzania, Dosimeters are managed by the Tanzania Atomic Energy Commission (TAEC) to lessen radiation risks for radiation workers. Nonetheless, after dispatching those dosimeters, the TAEC management room is unable to determine whether or not each supposed wearer has worn the dosimeter. This causes an incorrect assessment of an individual occupational radiation dose. As a result, a Dosimeter Wearers Monitoring and Reporting System for Radiation Areas was created using the Internet of Things (IoT). In the project we propose an efficient and cost-effective method for real-time remote monitoring and reporting workers wearing passive dosimeters when nearby or in the region; radiation exposure is too high using IoT technology. System development was done using the scrum technique, which is based on agile methodology. An ESP32 microcontroller board that was C-programmed using the Arduino Integrated Development Environment powered the device. Through its internal Wi-Fi, the ESP32 microcontroller was able to transmit da-ta to the web server. The end-user (TAEC management officer) was able to monitor and visualize radiation workers thanks to the mapping web application. The developed system made it possible to track and report on the dosimeter.

An Investigation on Internet of Things Technology (IoT) In Smart Homes

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Internet of Things technology is a rapidly growing industry and an essential necessity in the growth of smart homes as it provides home users with a very high level of convenience and efficiency to improve their lives. Over the last decade, several low and high-power technologies, wireless protocols, machine learning, cloud services and other technologies such as ROR, BAN AVISPA, J48 ML algorithm and Weka API, NFDA, Edge Computing Paradigm, Fuzzy Logic, KNX Technology, SYN & HTTP flood attacks, Scheffe's Regression Analysis, REST API, RF energy, OCTAVE etc. were used in the Internet of Things, and these have heralded a new era of smart houses. However, these heterogeneous devices have issues of security, privacy and dependability. This survey focused on analyzing and reviewing top-notch papers from reputable journals and publishers with the aim of proposing, designing, and implementing improved smart home systems to solve these technical issues of smart homes mainly privacy, security is-sues through the application of machine learning techniques/algorithms for predicting the usage behavior of these smart home occupants.

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