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Transforming Everyday Environments: the Power of Ambient Intelligence

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ABSTRACT

This paper on Ambient Intelligence (AmI) represents a transformative approach to integrating technology seamlessly into everyday environments to enhance human interaction and quality of life. By leveraging the synergy of ubiquitous computing, artificial intelligence, and the Internet of Things, AmI environments are designed to be sensitive, adaptive, and responsive to human presence and needs. This paper delves into the fundamental aspects of Ambient Intelligence including its core concepts of context awareness, personalization, and adaptability. We explore the key technologies driving AmI—sensing and data collection, data processing and analysis, and communication networks. Additionally, we highlight practical applications of Ambient Intelligence across various domains such as smart homes, healthcare, and smart cities, showcasing their potential to significantly improve daily life and operational efficiency. The paper also addresses the pivotal challenges of privacy, security, interoperability, and user acceptance that need overcoming to realize the full potential of AmI. By providing a comprehensive overview of Ambient Intelligence, this document aims to foster a deeper understanding and spur further innovation in creating intelligent, intuitive environments that anticipate and fulfil human needs.

Keywords

Ambient Intelligence, Smart Environments, Ubiquitous Computing, Context-Aware Systems, Intelligent Systems.

Beyond Binary Classification: Unraveling Nuances in Generative AI and Human-authored Texts Through Nlp and Statistical Data Analysis

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ABSTRACT

This research explores the nuanced differences in texts produced by AI and those written by humans, aiming to elucidate how language is expressed differently by AI and humans. Through comprehensive statistical data analysis, the study investigates various linguistic traits, patterns of creativity, and potential biases inherent in Human-written and AI-generated texts. The significance of this research lies in its contribution to understanding AI's creative capabilities and its impact on literature, communication, and societal frameworks. By examining a meticulously curated dataset comprising 500K essays which comprised a diverse range of text samples, spanning various topics and genres generated by LLM's or written by Humans, the study uncovers the deeper layers of linguistic expression and provides insights into the cognitive processes underlying both AI and human-driven textual compositions. The paper addresses challenges in assessing the language generation capabilities of AI models and emphasizes the importance of datasets that reflect the complexities of human-AI collaborative writing. Through systematic preprocessing and rigorous statistical analysis, this study offers valuable insights into the evolving landscape of AI-generated content and informs future developments in natural language processing (NLP).

Keywords

Linguistic analysis, AI-generated texts, Creativity patterns, Bias detection, LLMs (Large Language Models), Natural language processing (NLP).

An Approach to Demonstrate That a Cognitive System Does Not Have Subjective Consciousness

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ABSTRACT

With Large Language Models (LLMs) exhibiting astounding abilities in human language processing and generation, a crucial debate has emerged: do they truly understand what they process and can they be conscious? While the nature of consciousness remains elusive, this synthetic article sheds light on its subjective aspect as well as some aspects of their understanding. Indeed, it can be shown, under specific conditions, that a cognitive system does not have any subjective consciousness. To this purpose the principle of a proof, based on a variation of the thought experiment of the Chinese Room from John Searl, will be developed. The demonstration will be made on a transformer architecture-based language model, however, it could be carried out and extended to many kind of cognitive systems with known architecture and functioning. The main conclusions are that while transformers architecture-based LLMs lack subjective consciousness based, in a nutshell, on the absence of a central subject, they exhibit a form of “asubjective phenomenal understanding” demonstrably through various tasks and tests. This opens a new perspective on the nature of understanding itself that can be uncoupled with any subjective experience.

Keywords

Language models, transformers, subjective consciousness, understanding, asubjectivity.

Artificial Intelligence and the Data Storage Capacity for Growth

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ABSTRACT

This paper explores the relationship between data storage capacity and the growth potential of artificial intelligence (AI). Contrary to Nobel laureate Paul Romer's assertion that data limitations hinder AI growth, this report argues that both AI and human intelligence continuously generate new data, driving AI's development. The study includes data collection methods, relevant graphs, and references to multiple sources of data research and analysis.

Keywords

Artificial Intelligence, Data Growth, Human Intelligence, Data Segmentation, Big Data

Fuzzy Cognitive Maps as a Bridge Between Symbolic and Sub-symbolic Artificial Intelligence the Future is Hybrid

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ABSTRACT

The intersection of symbolic and sub-symbolic Artificial Intelligence (AI) presents a fertile ground for innovations that combine the interpretability of the former with the learning capabilities of the latter. This paper introduces Fuzzy Cognitive Maps (FCMs) as a hybrid model that encapsulates the strengths of both paradigms, proposing them as a viable solution to the challenges of explainability and interpretability in AI systems. FCMs have emerged as a compelling framework for representing causal knowledge and facilitating decision-making processes intuitively and

justifiably. FCMs can handle the inherent uncertainty and vagueness seen in real-world scenarios, thus enabling a more natural and flexible approach to problem-solving. This intrinsic flexibility, combined with the capacity for learning and adaptation derived from sub-symbolic AI, positions FCMs as an ideal candidate for applications demanding high degrees of explainability and interpretability.

Keywords

Fuzzy Cognitive Maps, Symbolic AI, Sub-symbolic AI, Explainable AI, and Interpretable AI.

AI-Powered Solutions for Missing Data in Pipeline Risk Assessments

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ABSTRACT

The use of Artificial Intelligence (AI) and Machine Learning (ML) in the oil and gas pipeline industry has shown significant promise, particularly in addressing challenges posed by incomplete datasets. This paper explores the application of AI in filling missing data for risk assessments, with a focus on safety-critical scenarios. Through a detailed process flow, this paper illustrates the potential pitfalls and risks associated with relying solely on AI-generated data. This paper also suggests strategies to balance AI reliance with real data acquisition, emphasizing the importance of consequence analysis, cost-benefit considerations, and a hybrid approach to ensure the safety and reliability of operations across the pipeline and broader oil and gas industry.

Keywords

Artificial Intelligence (AI), Machine Learning (ML), Risk Assessment, Pipeline Safety, ALARP

Detecting Droplets for Crop Spraying Systems Using Machine Learning

Debmalya Ray, India

ABSTRACT

Agricultural Development combined with technology has made great progress in recent years, making it possible to improve the yield for farmers. This project combines deep learning algorithms with spraying technology to design a machine vision precision real-time targeting spraying system for field scenarios. Highly efficient mechanized nozzles are used to spray and apply nutrients and pesticides to crops so that farmers can increase production and mitigate the gap between supplies and demands. We employ high-speed visualization [8] to quantify the impact and evaporation of a droplet on a solid surface. This will also help us to identify the density/area covered by a single spray at a time and correct the delta part left to be covered at first work. This paper is focused on using image classification techniques with a computer vision algorithm to extract the parameters required from a single image at a time and convert it into structured data so that an unsupervised algorithm can cluster the regions based on density.

Keywords

machine vision, image processing methods, unsupervised learning, droplets impact.

Web-based Automation Testing and Tools Leveraging AI and ML

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ABSTRACT

Software testing remains an essential phase of the software development lifecycle particularly for web-based applications. The integration of AI and ML automation testing has reached new heights in efficiency accuracy and coverage. This paper discusses the latest advancements in web automation testing tools that leverage AI and ML providing insights into their benefits and selection criteria.

Keywords

Automation Testing, AI, ML, Web Applications.

Robust Multi-modal Face Anti-spoofing: Handling Missing Modalities and Fusion Techniques

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ABSTRACT

Recent advancements in multi-modal learning have significantly enhanced face antispoofing systems. Despite these improvements, real-world applications often face the challenge of missing modalities from different imaging sensors. Previous studies have largely ignored this issue or have increased model complexity without effectively addressing it. This study presents a robust yet straightforward methodology utilizing a multi-modal face anti-spoofing architecture with spatial-temporal encoders and a dedicated fusion unit. The spatial-temporal encoders extract features from each modality using ResNet34 and Transformer architectures, while augmentation and regularization techniques further enhance model performance. Various fusion methods are assessed for their effectiveness in managing missing modalities. Additionally, we present FaceMAE, a modular autoencoder designed to predict and reconstruct missing-modalities. FaceMAE functions via a dual-phase process: encoding detected modalities to produce latent representations and subsequently decoding them to reconstruct missing modalities. Through the incorporation of transformer encoders and a flexible fusion module, FaceMAE enhances the ability to differentiate between live and spoof facial images. Evaluations on datasets such as CASIA-SURF, CASIA-SURF CeFA, and WMCA indicate that our method achieves competitive results.

Keywords

Artificial intelligence, Computer vision, multi-modal learning, face anti-spoofing, missing modality scenarios, face attack detection, Data augmentation, spatial-temporal encoders.

A Combine Cnn-rnn Based Approach for Augmenting the Performance of Speech Emotions Recognition

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ABSTRACT

Due to the advancement of neural networks and the increasing demand for accurate and real-time Speech Emotion Recognition (SER) in human-computer interactions, it is necessary to compare existing methods and databases in SER in order to arrive at feasible solutions and a complete understanding of this open-ended problem in SER. To detect and recognize the emotions expressed in speech, various techniques have been used in the literature, including well-established speech analysis and classification techniques. These techniques, including speech analysis and classification, have been used to extract emotions from signals. In this study, we propose a novel method for analysing signals called Wavelet-Scaled Spectrogram which combines the frequency and scale spectrum of a signal using wavelet transform. This method is effective in analysing signals at different scales and frequency content. In order to train models for speech emotion identification, a large number of handcrafted features and intermediary depictions i.e., frequency-time plot that have traditionally been utilized in data compilation, collection, and analysis. The development of end-to-end models which extract characteristics and learn directly from raw speech signals to improve speech recognition has recently been studied by re-searchers following the emergence of deep learning. After training and evaluation on the famous speech databases EmoDB, RAVDESS and IEMOCAP, the proposed model is evaluated on various speakers in both speaker-independent and speaker-dependent modes and on a variety of different voices. When advanced preprocessing techniques or data augmentation are omitted from the proposed architecture, the results demonstrate that it can produce products comparable to those produced by the current state of the art. Three concurrent CNN pipelines and a series of modified local features learning blocks (LFLBs) achieved the highest classification accuracy attainable.

Keywords

Artificial Intelligence, Network Intrusion Detection Systems, Machine Learning, Ensemble Models, Cybersecurity, Feature Selection.

Enhancing Sentiment Analysis for Low-resource Pashto Language: a Bert-infused Lstm Framework

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ABSTRACT

In the domain of Natural Language Processing (NLP), sentiment analysis plays a pivotal role, aiding in applications ranging from user feedback interpretation to customer sentiment tracking. However, the focus of sentiment analysis has predominantly centered on major languages such as English, side-lining the requirements of less commonly used languages. In this context, low-resource languages like Pashto encounter a considerable deficiency in sentiment analysis tools and resources, limiting their potential in the field of NLP. To address this critical gap, the proposed work is focused on Pashto sentiment analysis, a low-resource language, and utilizes Romanized Pashto data collected from Twitter using Tweepy, a Python library for accessing the Twitter API. To enhance the data quality, a sequence of pre-processing steps are implemented, encompassing the elimination of extraneous information, stemming, and vectorization. Additionally, in light of the absence of a Pashto language-specific stop words list and stemming dictionary, previous

research endeavours have faced limitations. In response, this study also proposed a proactive approach by crafting a comprehensive list of Pashto stop words and constructing a stemming dictionary called PasLex (Pashto Lexicon) with the guidance of domain experts. Using BERT as a tokenizer and combining it with Long Short-Term Memory (LSTM) network leads to improved sentiment detection. We also check the validity of the proposed model by combining BERT with Support Vector Machine (SVM) for sentiment classification. In both cases the proposed approach has outperformed the state-of-the-art methods by achieving highest accuracy, precision, recall, and F1-measure of 92.33%, 92.5%, 92.33%, and 92.32%, respectively.

Keywords

Sentiment Analysis, Low Resource Languages, Pashto, BERT, LSTM, SVM.

Security Concerns in IOT Light Bulbs: Investigating Covert Channels

Janvi Panwar Ravisha Rohilla

ABSTRACT

The proliferation of Internet of Things (IoT) devices has raised significant concerns regarding their security vulnerabilities. This paper explores the security risks associated with smart light systems, focusing on covert communication channels. Drawing upon previous research highlighting vulnerabilities in communication protocols and encryption flaws, the study investigates the potential for exploiting smart light systems for covert data transmission. Specifically, the paper replicates and analyzes an attack method introduced by Ronen and Shamir, which utilizes the Philips Hue White lighting system to create a covert channel through visible light communication (VLC). Experimental results demonstrate the feasibility of transmitting data covertly through subtle variations in brightness levels, leveraging the inherent functionality of smart light bulbs. Despite limitations imposed by device constraints and communication protocols, the study underscores the need for heightened awareness and security measures in IoT environments. Ultimately, the findings emphasize the importance of implementing robust security practices and exercising caution when deploying networked IoT devices in sensitive environments.

Internet of Things: Domesticated Toolsets for Solving Major Challenges Faced by Individuals With Health Problems

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ABSTRACT

In this modern era of globalization, technology has increasingly infiltrated all aspects of human life. Health is no exception to this advance. Provision of health services has undergone evolution to reach the current status. However, many people, especially in developing countries, do not enjoy optimum health services due to several constraints. This is where technology continues to grow and be beneficial for all strata of society. From the direct provision of health services, technology can also help to prevent, optimize diagnosis, and treatment of diseases. One of the latest breakthroughs in health service provision is the integration of the Internet of Things (IoT). Utilization of IoT is expected to bring a radical change to the provision of health services. This is in line with the principle approach of preventive, predictive, and personalized that so far has not been applied optimally due to limitations and constraints of health resources.

Keywords

Globalization, internet of things, health, quality of life, chronic conditions, companion devices, wearable devices.

Forecasting Network Capacity for Global Enterprise Backbone Networks using Machine Learning Techniques

Kapil Patil and Bhavin Desai

ABSTRACT

This paper presents a machine learning approach to forecasting network capacity for global enterpriselevel backbone networks. By leveraging historical traffic data, we develop a predictive model that accurately forecasts future demands. The effectiveness of our approach is validated through rigorous testing against established benchmarks, demonstrating significant improvements in forecasting accuracy.

KEYWORDS

Network capacity forecasting, Machine learning, Time series forecasting, ARIMA, Predictive modelling & Capacity Planning.

The Toe Theory and Cloud Computing: Exploring Factors Affecting the Adoption of Cloud Computing

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ABSTRACT

This study investigates the elements anticipated to affect healthcare hospitals' decision to use cloud computing. A quantitative technique is applied in this work. To find out how prepared and able the IT departments of various hospitals were to embrace cloud computing, 200 questionnaires were utilised. The decision of organisations to view cloud computing as a wise investment was influenced by Technology, Organisational, and Environmental aspects (TOE), as determined by multiple regression testing of the data. The study's results revealed that every element significantly improved hospitals' intention to use cloud computing, with the technological element having the biggest influence on the choice.

KEYWORDS

organizations, adapt, global market, efficiency, IT industry, cloud computing, investment, environment, technological advancements.

Factors Affecting on-time Delivery in Hybrid Software Project Management in the Context of Bangladesh Software Firms

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ABSTRACT

This study examines the critical factors influencing the timely completion of software projects within Bangladesh's software industry. It identifies several challenges, including skill gaps, communication barriers, inconsistent project lifecycles, budget constraints, inadequate capacity planning, cultural resistance, and regulatory compliance issues. The study highlights the agility of

small firms in adopting hybrid methodologies and the significant impact of project delays on their operations. To address these challenges, it proposes solutions such as advanced time estimation techniques, adaptive project management frameworks, enhanced stakeholder management tools, and improved resource management software. The research aims to provide actionable insights and practical guidelines to enhance the efficiency and effectiveness of hybrid project management practices, ensuring on-time delivery and better project outcomes in the Bangladesh software sector.

Keywords

Hybrid Project Management, Project Lifecycle, Budget Constraints, Cultural Resistance, Agile Methodologies, Stakeholder Management, Time Estimation Techniques.

Challenges with Securing Digital Identity

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ABSTRACT

Ensuring the security of digital identities has become increasingly critical in today's interconnected world. This paper examines the multifaceted challenges associated with securing digital identities, spanning technological, human, legal, and regulatory aspects. Key technological hurdles include vulnerabilities in authentication mechanisms, risks associated with biometric data, issues with multi-factor authentication, and challenges in implementing secure hardware. Human factors like social engineering threats, lack of awareness and education, insider threats, and psychological impacts of identity theft further complicate the landscape. Legal and regulatory hurdles such as compliance with data protection laws, cross-border data security issues, establishing digital identity standards, and balancing privacy and security concerns pose additional obstacles. The paper highlights the severe implications of unsecured digital identities and provides recommendations for enhancing security through a multi-pronged approach involving technological advancements, educational initiatives, and ethical considerations. A call to action emphasizes the urgent need for future research and collaborative efforts to bolster encryption, authentication protocols, and policy enforcement mechanisms in the digital domain.

Keywords

Digital Identity, Multi Factor Authentication, Security, Threat Detection, Identity Theft.

Reforming Biological/biomedical Science Teaching and Education: a Reflection on Welldeveloped Practices and Approaches in Large Class

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ABSTRACT

Making students efficiently understand and master the knowledge of biology/biomedicine by prompting active learning and critical thinking and making biology/biomedicine courses form an integrated system, are critical for more successful and effective student education. However, the current biological/biomedical education system tends to produce graduates best suited for academic careers in highly specialized areas. Many institutions favor densely packed curricula with fast-paced instructions focused on detailed subject matter, with little room is left for skill training in active learning, critical thinking, and creative problem solving, despite their significance. In this article, we discuss current defects in biological/biomedical science education and the need to reform biology/biomedicine teaching and education. We are particularly reflecting on approaches/strategies that we develop to improve biology/biomedicine teaching and learning, particularly in large classes that are challenging. This article has implications for students,

instructors, and curriculum designers in higher education, and help to face challenges of biology/biomedicine learning.

Keywords

biomedicine, biology, teaching reform, active learning, student engagement.

The Role of Games and Artistic Expressions in Decolonising Peace Education in Africa: a Scoping Study.

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ABSTRACT

This paper extends the notion of indigenous methods of peace education in Africa by exploring the use of games, artistic expressions and crafts in peace education in Africa, through a case analysis of selected countries from Southern and West Africa. The use of a scoping study method to put together literature for compiling secondary data for the study was corroborated with telephone interviews with 6 women informal peace educators and 6 peace students from both formal and informal peace education backgrounds. The research established the power of games, art and crafts as indigenous methods for peace education from antiquity Africa to date, the symbiotic relationship between artistic expressions and society, the value of games, arts and crafts as stimulants for emotional intelligence and the relationship between positive emotional intelligence and peace.

Keywords

Peace education, Women, Games, Artistic expressions, Crafts.

On-Line Pedagogical-training During Covid-19 Pandemic Crisis

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ABSTRACT

The COVID-19 pandemic led to the widespread closure of educational systems, prompting a shift to online learning. This study explores the responses of pedagogical instructors in a multicultural college of education in Israel during the crisis. Through semi-structured interviews with six instructors, the research investigates their roles in pedagogical training, management strategies, and emotional and pedagogical responses. Findings underscore the significance of pedagogical instructors in facilitating distance learning, particularly in adapting to the changing learning environment. Digital tools were crucial in facilitating interaction between teachers and students, with instructors likened to conductors orchestrating participation. Amidst the educational transformations caused by the pandemic, pedagogical instructors played a pivotal role in maintaining continuity and functionality in schools.

Keywords

Pedagogical instructors, Pedagogical training, Covid-19, On-Line Learning, Responses.

Design and Implementation of an AI-powered Online Teaching System for Information Technology Courses

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ABSTRACT

In the wake of rapid advancements in artificial intelligence (AI), the field of education stands at the cusp of a transformative era marked by unprecedented opportunities and challenges. Information technology (IT) courses, integral to modern pedagogy, play a pivotal role in nurturing students' IT competencies and fostering a spirit of innovation. However, traditional classroom teaching methods often grapple with inefficiencies and the difficulty of catering to individual educational needs. The rise of online learning presents a novel avenue for IT course instruction, and integrating AI with these courses paves the way for an innovative teaching paradigm. This paper endeavors to architect an AI-based online teaching system for IT courses that promises an efficient, personalized, and interactive learning experience. By harnessing AI technologies and aligning them with IT curricula, the system is designed to facilitate intelligent teaching, adaptive learning, and personalized tutoring. The research delves into the untapped potential of AI in IT education and scrutinizes critical aspects of system design, encompassing teaching content management, learning path planning, knowledge recommendation, and student assessment. Through empirical studies and practical applications, the feasibility and efficacy of the proposed system are validated. The findings of this study are expected to offer an innovative approach and toolkit for IT course instruction, providing students with a more efficient, personalized, and interactive learning experience. Furthermore, by leveraging the strengths of AI, the design of smarter and more personalized teaching models can offer valuable insights and experience for educational reform and development.

Keywords

Artificial Intelligence, Information Technology, Online Teaching, Teaching Systems, Personalized Learning.

Analysis of Spectrum Occupancy Prediction Results for Maitama Abuja

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ABSTRACT

This research analyzes spectrum occupancy in Maitama, Abuja, using Artificial Neural Networks (ANN) to predict usage across frequency bands from 30 MHz to 300 MHz. Predicted spectrum occupancy was compared with actual measurements to assess accuracy. Results for different bands show that prediction errors were generally low, often below 1.5%. The 30-47 MHz band had an average error of $8.7 \times 10^{-2}\%$, peaking at 1.12%. For the 47.05-68 MHz band, the average error was $10.61 \times 10^{-2}\%$, with a maximum of 2.18%. In the 68.05-74.8 MHz band, the average error was $3.99 \times 10^{-2}\%$, peaking at $23.24 \times 10^{-1}\%$. The 74.85-87.45 MHz band showed the lowest average error of $0.99 \times 10^{-2}\%$, peaking at $17.38 \times 10^{-1}\%$. Other bands had similar low error rates, demonstrating the high accuracy of ANN in predicting spectrum occupancy. The highest overall error was $10.61 \times 10^{-2}\%$ in the 47.05-68 MHz band, while the lowest was $0.99 \times 10^{-2}\%$ in the 74.85-87.45 MHz band.

Keywords

ANN, Prediction, PSD, dBm, VHF.

Optimization of Weight Function for (3+1)d Phonon Propagation in Weyl Fermion Sea Expressed by Clifford Algebra Using Elman Rnn and Echo State Network

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ABSTRACT

We modify the lattice simulation of (3+1)D Quantum Chromo Dynamics using fixed point actions by replacing Dirac fermions to Weyl fermions expressed by biquaternions. Paths of phonons are described by the weight function of eigenfunctions. The optimization is performed by using Elman Recurrent Neural Network and the Echo State Networks. Numerical results of the two optimizations are compared. We compare in lower dimensional systems the Time-Reversal based Nonlinear Elastic Wave Spectroscopy and the theory based on Quaternion Field Theory.

Keywords

Clifford Algebra, Quaternion Field Theory, Elman Recurrent Neural Network, Echo State Network.

"Refugee Watch" - an Extensible Framework for Forecasting Climate Measures to Assist Refugee Camps Globally and Raise Awareness

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ABSTRACT

Refugees worldwide suffer enormous traumas from the loss of family members, lifetime savings, homes, and other cherished valuables. As they attempt to reclaim their “normal” daily lives in refugee camps, they are deprived of basic life essentials such as food, and safe and clean water. Nutritious goods like fresh fruits are privileges, while electricity and books are luxuries. Collectively, it takes little effort to imagine the living conditions of young children in these camps. With the frequent but unpredictable occurrences of extreme weather events, maintaining self-reliance through agricultural activities around their “temporary” homes in refugee camps is increasingly difficult. The United Nations describes drought emergency demands as unprecedented, anticipating immense challenges in maintaining agricultural farms in refugee camps. Accordingly, we developed a proof-of-concept called “Refugee Watch”, a one-stop reproducible framework that helps researchers pull data on-the-fly from data servers and try out forecasting methods with real-time series data. Implemented in Streamlit, a lightweight deployment framework for web applications, our reproducible framework is accessible at <https://refugee-watch.streamlit.app/> and will be made cloneable and extensible via GitHub (shared after blind review). We hope this tool will provide an entry point for researchers and non-technical social scientists to visualize climate data, assisting policymakers in designing and implementing strategies to aid refugees living in poor conditions amid climate changes.

Keywords

Refugee, weather forecast, lightweight prototyping.

A 63.74 Dbo Gain 60.84 Ghz Bandwidth Power-efficient Transimpedance Amplifier in 130 Nm Sige Bicmos Technology

Lavakumar Navilipuri and Andy Heinig, Fraunhofer Institute for Integrated Circuits IIS/EAS, Germany

ABSTRACT

This paper presents the design and analysis of a high-performance Transimpedance Amplifier (TIA) tailored for high-speed optical communication systems. The TIA utilizes a Darlington pair topology with Negative Resistive Feedback to achieve high transimpedance gain and wide bandwidth. Through detailed circuit analysis and simulation, the TIA exhibits a transimpedance gain of 63.7 dBO and a bandwidth of 60.84 GHz after layout implementation, making it suitable for high-speed data transmission applications. The TIA also demonstrates low input-referred noise of 16.20 pA/vHz and consumes only 31.53 mW of DC power, highlighting its power efficiency. Comparative analysis with existing TIAs showcases the effectiveness of the proposed design, which achieves impressive performance without the need for additional circuitry. This study contributes to the advancement of high-speed optical communication systems by providing a simple yet effective TIA design that balances performance, efficiency, and simplicity.

Keywords

Darlington Pair, Optical receivers, SiGe BiCMOS technology, transimpedance amplifier.

Exploring Transimpedance Amplifier Topologies: Design Considerations and Trade-offs

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ABSTRACT

Transimpedance amplifiers (TIAs) play a crucial role in converting current signals from sensors, photodiodes, and other transducers into voltage signals for processing in various electronic systems. In this paper, we explore three distinct TIA topologies: common emitter with negative resistive feedback, regulated cascode, and Darlington pair with negative resistive feedback. Each topology offers unique advantages and trade-offs in terms of bandwidth, gain, and noise performance. We analyze the characteristics of each topology, discussing their impact on TIA design and performance. Through theoretical analysis and circuit simulations, we investigate methods to optimize gain, bandwidth, and noise performance for different application requirements. Our findings provide valuable insights into TIA design considerations, offering engineers a comprehensive understanding of TIA topologies and their implications for electronic system design.

KEYWORDS

Common Base, Common Emitter, Regulated Cascode, Darlington Pair, Optical receivers, SiGe BiCMOS technology, Transimpedance Amplifier.

Gallium Oxide – A Review

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ABSTRACT

Gallium oxide (Ga_2O_3) is a promising material for a wide range of applications, including electronics, optoelectronics, and power devices. This review provides a comprehensive overview of the synthesis, properties, and applications of gallium oxide. The synthesis of Ga_2O_3 is discussed, including various techniques such as vapor deposition, sputtering, and hydrothermal methods. The properties of Ga_2O_3 , including its wide bandgap (4.8eV), high thermal conductivity, and high breakdown voltage, are described. The applications of Ga_2O_3 are discussed in detail, including electronic devices such as transistors, diodes, and solar cells. The use of Ga_2O_3 in optoelectronic devices, such as light-emitting diodes (LEDs) and photodetectors, is also covered. Finally, the potential applications of Ga_2O_3 in power devices, such as power diodes and switches, are explored. Overall, this review provides a comprehensive overview about this versatile material.

KEYWORDS

Gallium Oxide (Ga_2O_3).